Concrete

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How About the Buildings?

THERE is almost overwhelming testimony from concrete building contractors that the proposal of the Joint Committee to permit the specification of concrete by strength is unworkable with our present knowledge and field control. There is also a seeming disregard of the predicament of the engineer who is trying to design a building economically and safely, when he can't rely within 500 to 1000 lbs., upon the contractor's ability to deliver a building whose structural members may not test up to requirements.

There are unquestionably matters of the economical field control of concrete proportioning, mixing, placing and curing which would put the builder under a severe handicap, making lawsuits almost a certainty, if he had to guarantee say 2000 lbs. strength on 28 day tests. The contractors point to thousands of their buildings which are entirely satisfactory and rest their case largely on that and the fact that the results from test cylinders under test conditions imposed are not truly indicative of strength in the building.

The fundamental situation remains the same: what is the use of accurate design which is to be executed by inaccurate construction? A kind of keynote in the discussion, which lasted all through the last day of the Institute's Cleveland convention, was sounded by Ernest Ashton when he put the matter up to the contractors like this:

"I note that most of those who have discussed this matter view with considerable alarm and apprehension the great variation existing in concrete test specimens; I wonder whether they view with the same alarm and apprehension the concrete that they now have in structures—where there was very little or no control?"

The Far Apartness of the Products Field

THE concrete products sessions of the American Concrete Institute convention were in a sense disappointing. They were disappointing chiefly because they did not develop any strong evidence of class feeling.

A class feeling is the first forward step from individual feeling. The next step is a public feeling—wherein the class interest is merged in the public interest.

The principal thing the matter with the concrete products industry is due to the fact that too many manufacturers see their own individual problems and difficulties and do not recognize in these the common needs of the whole products industry. They haven't got the get-together idea.

The Institute has made a good start toward crystalizing the feeling for organized progress in the products field and a considerable number of the more progressive manufacturers have recently become members. The progressives, even an earnest few, can do wonders. Another year should show much better results. There are two or three excellent rallying points. The fire tests which Committee P-5—on Fire Resistance of Concrete Building Units, proposed and described in detail and for which the Institute Board of Direction has appropriated $500 as the nucleus of a fund to pay for the tests—this program will force itself on the attention of concrete building unit manufacturers and compel a consideration of Institute standards.

Then there is the matter of the debated specifications for building units. Due to the split in the ranks, (between block and building tile), gone into in detail in other pages, no progress was made this year, but the split aired the whole situation and makes possible more definite progress in the coming year.

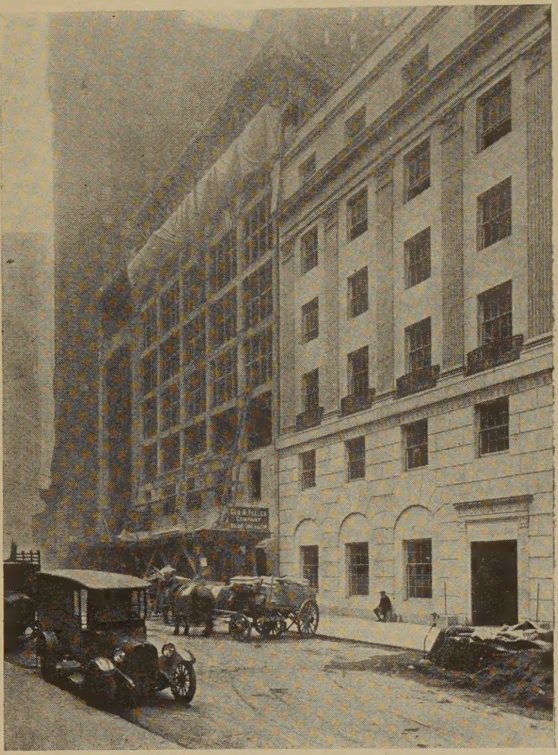
The activities in the field of pipe and drain tile are much more satisfactory. This part of products manufacture has class feeling. It knows how to get together.

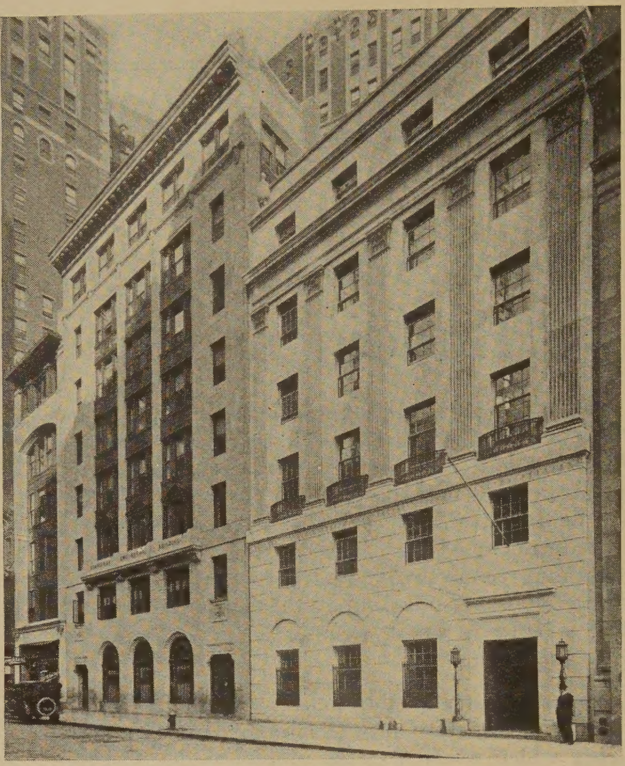
The Institute

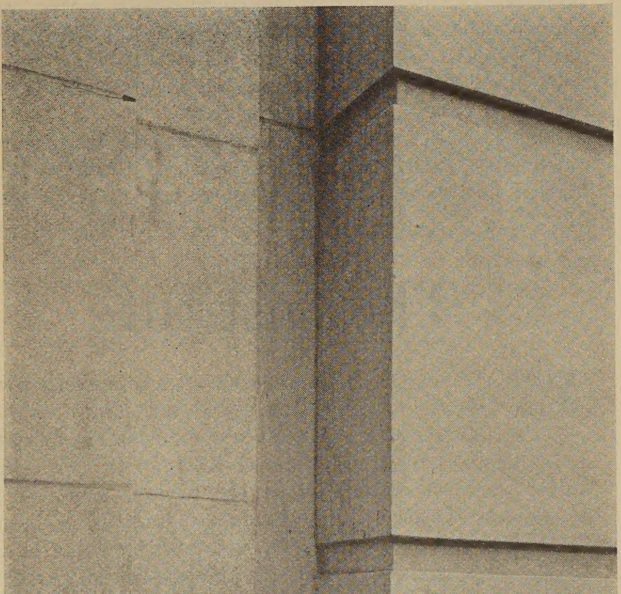
THE American Concrete Institute is coming nearer and nearer to fulfilling its mission. The convention in Cleveland in February was characterized not only by a larger attendance than at Chicago in 1921, but a better average attendance at the various sessions. The sessions on Houses, Field Problems, and Joint Committee report discussion were of outstanding value and interest. The demonstration of the steps in designing and mixing a concrete for a given strength as given by Stanton Walker, of the Structural Materials Research Laboratory, following a discussion by Prof. Duff A. Abrams, provided two hours in which scarcely a man left his seat except to get closer to the stage.

The Institute has shown a most healthy growth. At the time of the convention of 1920 it had 428 members; in 1921, 627 members and at the close of the 1922 convention it had more than 870 members. There is a corresponding improvement in financial condition.

A Row of Buildings on Broad Street







On Broad Street, in New York, You May See, Side by Side, All in a Row, Four Buildings, All Fine Structures, That Provide an Interesting Study in Comparisons—Part of Them Shown in the Accompanying Illustrations

In the upper right view you see three—and just the edge, at the extreme right, of a fourth building. The farther building is the Alliance Realty Co. structure, built in 1908 by Moffatt and Watson, contractors, under the supervision of Clinton & Russell, architects. It is built of white marble. The one at the right is the Post & Flagg structure, 41-51 Broad street, built with white marble exterior in 1920 by Cauldwell-Wingate Co., George B. Post & Sons, architects. At the extreme right you can just see the edge of a building; it is a structure with a Bedford limestone front. In the center is the Combustion Engineering building, 43-45 Broad street, erected in 1920, George A. Fuller, contractor, Ludlow & Peabody, architects, with a front of manufactured stone, a beautiful rubbed finish concrete stone—Benedict cast stone. The picture at the left above shows the concrete stone building under construction around a reinforced concrete frame. In the lower picture is a close-up of the juncture of the concrete stone (left) with the white marble (right). The smooth, finely textured surface of the concrete is flecked with the white of the aggregate, a white marble.

American Concrete Institute Convention

The American Concrete Institute's eighteenth annual convention, February 13-16, at Hotel Winton in Cleveland, was remarkable for its sustained interest and attendance through nine sessions spread over four days, instead of the usual three.

Except for the 1918 and 1919 conventions, in and immediately following the war period, when meetings were planned jointly with the American Society for Testing Materials, to economize time and travel at what was a low tide of Institute affairs, largely as a result of the war, meetings in recent years have been in Chicago, because Chicago was the center of a good deal of organized activity in the Institute's field.

In breaking away from Chicago temporarily, as a meeting place, the Institute risked considerable dependable support. Cleveland had, previous to this last convention, a very small Institute membership. It was very gratifying, therefore, to the Institute's officers and directors, responsible for the change, to note a registered attendance of 286, as compared with 244 in Chicago the previous year.

The membership has been increasing steadily even in an "off year." The membership at the time of the 1920 convention was 428; at the time of the 1921 convention 627, and at the close of the 1922 convention 873. The financial condition of the Institute has shown steady improvement. The margin between active membership dues and per capita cost of Institute publications is still small, but is increasing with growth in membership.

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Henry C. Turner, president of the Turner Construction Co., New York City, retired after two years as president of the Institute, to be succeeded by W. P. Anderson, president of the Ferro Concrete Construction Co., Cincinnati, for several years a vice-president. A. E. Lindau, of the Corrugated Bar Co., Buffalo, and M. M. Upson, of the Raymond Concrete Pipe Co., New York, were elected vice-presidents. Charles E. Nichols, of Stone & Webster, Inc., Boston, is the only other new member of the Board of Direction. Harvey Whipple, Editor of CONCRETE, Detroit, was re-elected treasurer and the Board reappointed him secretary.

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Of outstanding interest in the convention were sessions on Field Problems, opening with a discussion and an actual demonstration in making a concrete mixture, designed from available materials for a specified strength; on House Construction, on Design—devoted almost entirely to a discussion of the progress report of the Joint Committee; and on Concrete Products Manufacture. A social evening, with moving pictures, pink lemonade, apples, doughnuts, corncob pipes, and legerdemain (by F. J. Straub, of New Kensington, Pa.), was a success.

Prof. H. M. Westergaard, of the University of Illinois, was awarded the Wason medal for his part of the paper presented jointly with W. A. Slater. The paper was presented at the 1921 convention, on "Moments and Stresses in Slabs." Mr. Slater was Wason medal winner for another paper, presented a few years ago.

The presentation of the medal was made by A. R. Lord, of the Wason Medal Committee, in the absence of Sanford E. Thompson, chairman.

The Wason medal is given each year to the author of the most meritorious paper included in the previous year's Proceedings of the Institute, and was instituted by Leonard C. Wason, past president of the Institute.

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Highway Problems

Committee S—6 on Concrete Roads, which has been working to bring the recommended practice and specifications up to date, was not ready to report, because many things hang upon nation-wide research which is under way. In a brief outline of road work by C. R. Ege, secretary of the committee, it was pointed out that the work of the Illinois State Highway Department, with an experimental road shut off from traffic, to be tested to destruction; the experiments of the Bureau of Public Roads with slabs from 2 in. up to 10 in., tested by machine for impact; and the testing of an oval track in California, were mentioned as practical tests likely to produce valuable data for future road work.

Experience shows that the proportioning of concrete has more to do with its quality than the character of the coarse aggregate. This fact is important in the selection and utilization of aggregates available near the work in hand. Parallel slab construction developed during the last 18 months was described by Mr. Ege. The construction of the double slab with a longitudinal joint along the plane of weakness allows free action under temperature changes. In a case under observation the single slab tended to curl down during the day and reverse at night. In an extreme case the slab was found to have separated from the subgrade as much as 0.1 in. at the edge. The longitudinal joint also permits the construction of half the width of the road at one time, which is a distinct advantage, especially where detours are established with difficulty. Under proper regulation traffic can be maintained over one side of the road while construction of the other longitudinal half is being paved.

Joints and Waterproofing for Bridges

Problems of waterproofing, expansion joints, and construction joints, and drainage were singled out for special consideration in this year's report by the Institute Committee S—2 on Reinforced Concrete Highway Bridges and Culverts, A. B. Cohen, chairman. The committee expressed the belief that the embodiment of good practice is not confined to theoretical economies based upon actual quantities of concrete, steel reinforcement and other materials, and that the surity of a positive water repellant protection, the development of an effective expansion joint, the determination and arrangement of construction joints that will not weaken the structure nor exceed the capacity of a plant layout commensurate with the magnitude of the work, and finally the distribution of a drainage system to downspouts, are subjects of equal importance. These four considerations are believed to be so closely allied and of such importance that the details might be developed coherently, bearing materially on the type of superstructure selected.

Waterproofing systems in general concrete work can be divided into three classes; membrane, integral, and the pointing or plaster treatment.

The membrane system consists of laying or building up a water repellent blanket over the surface of the concrete where the surface is exposed to drainage or water pressure. The waterproofing medium is either asphalt or coal tar pitch, which is applied hot and is reinforced and held in place by laying a sheet of felt paper or other material after each swabbing of bitumen.

The integral method consists of the incorporation of a compound in some form with the concrete during mixing, so as to produce maximum density and chemical action intended to decrease the permeability of concrete.

The pointing or plaster treatment consists of the application of paints or the integral method used in cement mortar, and applied like plaster to the surface of the concrete. A rubbing treatment also has been used, working the compound into the surface of the concrete.

Integral methods are not considered as having a function in waterproofing bridges of such size that construction joints are necessary, since in such structures the incipient cracks and contruction joints make such methods inapplicable. Although by properly proportioning the aggregates and mixing the concrete a mix could be obtained giving a concrete of the highest density, the actual density of the finished product depending largely upon the manner in which the concrete is placed in the forms, due to the personal equation which is not fully controlled on the work.

Owing to the fact that coal tar pitch is more susceptible to changes in temperature than asphalt, asphalt is considered better suited to meet the outstanding requirements for service. Before recommending tentative standards for bituminous waterproofing, the committee consulted independent authorities.

Plans should show complete details of the waterproofing system. Arrangements prohibiting a continuous waterproofing blanket should be avoided. All concrete surfaces to be waterproofed should be carefully prepared so that no large aggregate is left projecting that might puncture the membrane. The waterproofing membrane shouould be protected by a layer of 1:3 cement-sand mortar or common brick.

Expansion Joints

The distance apart of expansion joints in concrete construction, which are necessarily at closer intervals than would be necessary in steel structures of similar magnitude, depends upon the type of structure and no specific recommendations relative thereto can be safely given by the committee.

Broadly speaking, there are three types of highway bridge design requiring expansion joints; first, the arch type, with superstructure composed of transverse or longitudinal walls supporting a floor system or with back fill of earth where the sidewalk construction is cantilevered from a parapet wall; second, the T-beam or rectangular slab design, supported on columns or bents; third, the multiple way reinforced flat slab structure on columns. The latter type has not been extensively used, but there is a wide field for its application.

In the development of expansion joint details, the following considerations should be borne in mind. In the arch type, with superstructure, expansion joints in the superstructure must provide for movement in both a vertical and horizontal direction—up and down for rise and fall of the arch ring and in a horizontal direction due to elemental changes of length in the various members of the floor system.

Where transition for these non-concurrent movements from one section to another is attempted in the superstructure by sliding or vertical surfaces in contact, there is the imminent danger of a shearing failure in these sections in contact, caused by excess of frictional or tortional action over the strength of the section in shear.

Joints placed at the quarter points of the span, approximately at the point of contraflexure in the arch ring, and at the pilasters adjacent to the piers, have proved successful for spans of 90 ft. to 200 ft. This arrangement divides the floor system over each arch in three sections, and eliminates an extremely large moment in the floor system over the haunch of the arch, due to a maximum vertical movement at crown of arch. The amount of moment or tension in the floor system due to vertical movement of the main arch ring varies with the ratio of rise to span; the flat segmental arch causes greater moment than the semi-circular arch of equal span. The principle or effect of the cantilever joint in floor system can be secured in the parapet wall construction of a barrel arch supporting earth fill, by vertical joint through the walls and sidewalk.

For the second type, the T-beam or rectangular slab design supported on columns or bents, the action to be controlled is in the horizontal direction only. In the T—beam type there arises the difficulty of transferring the movement due to temperature changes from the larger through the smaller members as from the deep beams through the slabs. Regardless of the length of structure, the slab should be substantially reinforced in transverse direction to distribute stress or prevent a cumulative strain at change of sections.

The ratio of span length to height of columns or bents should be taken into consideration.

For sliding joints, plates of steel, copper, zinc, or lead, and multiple layers of fabrics or combination of these different plates have been used to reduce friction resistance. Where the bearing covers a wide area there is the danger, if heavy plates are not used, that the sliding medium or plate will conform to a possible uneven surface of a bridge seat and cause a crack. Therefore, great care must be exercised in preparation of the sliding joint or bridge seat, as it is generally called.

The third type, the flat-slab construction, can be built in greater lengths between expansion joints than either of the preceding types. Because of the uniform cross section everywhere of both concrete and steel, the slab offers better resistance to temperature changes, the movement being distributed more uniformly throughout its entire length. Expansion joints in this construction are formed by double row of columns, and in good practice the joints should be spaced at distances not exceeding 250 ft.

Construction Joints

The location of construction joints should be shown on the plans, since this detail is a decided help to the contractor in his analysis of the contruction problems. The designer should bear in mind the capacity of plant commensurate with the magniture of the work.

The lengths of reinforcing rods should be predetermined, so that no excessive lengths of rods project beyond the construction joint. The rods should project beyond the bulkhead forming the construction joint far enough to develop bond strength with the next lift of bars. In beam or slab construction, the joint is placed at point of least shear, or maximum moment, and no lap of bars should be made at this joint.

Gravity walls should be built in one operation from footing course to the underside of the coping. Construction joints should be placed at intervals not greater than 30 ft. By addition of temperature steel, sections can be increased to 50 ft. in length. Vertical joints are more desirable than horizontal joints, which tend to become unsightly cracks, due to the resulting efflorescence and gradual disintegration at the joint. Dovetailing adjoining sections and placing copper flashing in the joint are added precaution tending to seal the joint against percolation of drainage water. Construction joints should be avoided along any plain in the structure where water is liable to be concentrated.

DRAINAGE

The outstanding consideration in detail of drainage of a bridge floor is to lead the water to down-spouts placed at close intervals so that no large amount of water is carried over long distances or no large amount leads to one single down-spout, which would tend to choke up by ice in freezing weather. If possible, dykes should be built integrally with the floor slab adjacent and expansion joints. Various methods may be used to make extension joints water tight.

Several plies of tar paper wrapped around down-spouts in concrete sections will provide for possible expansion of the metal drain pipe. Icicles can be prevented to large extent by placing perforated copper baskets filled with rock salt at the top of each drain pipe.

In retaining wall construction, where backfill carries an unusual amount of water, trench drains built up around the weep holes at ground level will facilitate flow of drainage. Weep holes should be made large, and so that they can be readily cleaned.

The committee will have for consideration in formulating a report for the next convention a thorough study and investigation of the action of skew arches.

MOTION PICTURES—ROAD BUILDING

Motion pictures showing modern equipment and methods applied to concrete road building were shown by George A. Sherron, of the Koehring Machine Co., Milwaukee, Wis.

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Concrete Houses

Recommended Practice for House Construction

In a progress report of Institute Committee S—5 on Reinforced Concrete Houses, recommendations were presented varying somewhat from the report of the committee last year.[1] The committee believes that the report should cover recommended practice for design of concrete dwelling houses of all types. It should be of such a nature as to enlighten the architect, engineer, builder, owner, and tenant. That it is not enough to have specifications for strength and thickness of wall is the belief of the committee.

Three main subjects are considered: (1) general information, (2) standards, (3) recommended building regulation for concrete houses. All information for all concerned with concrete houses should be included in the specifications.

The committee's progress report on recommended practice applies to the construction of houses not exceeding 32 ft. high between top of first floor and underside of third floor ceiling, as compared with 30 ft. in last year's report. The minimum thickness of monolithic concrete basement wall is increased from 6 in. to 8 in. In analyzing the ability of the basement walls to resist the horizontal pressure of the earth, the weight of the superstructure shall be considered as a vertical force against overturning.

The minimum thickness of basement walls of precast units equal in length to the height of basement and anchored at the bottom to footing or basement floor, and at top to the first floor, is recommended as 8 in. if of plain concrete, compared with 7 in. formerly specified. If of reinforced concrete, they shall be designed to carry the vertical loads plus a horizontal earth pressure of 50 lbs. per sq. ft.

The following recommendations are made regarding the use of concrete block, brick, or tile and filler walls between columns and piers:

(c) *Concrete Block, Brick or Tile*—The thickness of basement walls of concrete hollow block, brick or tile shall be not less than 8 in. and shall be at least 1 in. thicker than the thickness of the outside wall of first story of superstructure. Concrete block or tile used for basement walls shall conform to the requirements of the report of Committee P—1 for 1922, American Concrete Institute.

(d) *Filler Walls Between Columns or Piers*—Concrete slabs used as filler walls between columns or piers shall be designed for the moment produced by earth pressure assumed to be horizontal and amounting to 50 lbs. per sq. ft. of wall in contact with the earth fill.

Single solid exterior bearing walls of plain concrete are to have a minimum thickness of 6 in. where 4 in. was allowed as a minimum in the previous recommendations. Twenty-five pounds per sq. ft. is specified as the uniform wind load to design for on the vertical projection of exposed surfaces for walls having reinforcing steel in excess of 0.2%. The minimum thickness of 4 in. of a bearing wall of double concrete walls is provided for, and if greater thickness is needed to carry the loads, positive means are to be provided to transmit the loads to both walls.

A design for wind pressure of 25 lbs., instead of 30 lbs., per sq. ft. on exterior walls which act merely as curtain walls in a reinforced concrete framework, is allowed.

That reinforced concrete structural units which act at the same time as load carrying elements and enclosing members shall be proportioned according to accepted engineering design and carry both vertical and horizontal loads, is recommended. Exterior bearing walls of precast units bonded together are to be designed to carry both vertical and wind loads, or are to conform to the wall thickness specified for concrete blocks, bricks, or tile in this section. Reinforced concrete units connected on two opposite edges to structural members designed to carry all loads to the foundation originating from the weight of the building or from wind pressure shall have dimensions and reinforcement determined by bending stresses produced by wind pressure of 25 lbs. per sq. ft. on exposed surfaces.

The following recommendations are added for concrete hollow block, brick, or tile:

(d) *Concrete Hollow Block, Brick, or Tile*—The following table shall govern the thickness of superstructure walls of concrete hollow block, concrete brick, or concrete tile:

WALL THICKNESS IN INCHES
FOR CONCRETE HOLLOW BLOCK, CONCRETE BRICK AND CONCRETE TILE

No. of Stories	Basement	1st Story	2nd Story	3rd Story
1	8	8	..	..
2	10	8	8	..
3	12	10	8	8

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[1] CONCRETE, March, 1921.

The use of some positive mechanical device for locking the reinforcement in a predetermined position during construction is specified. For mixing the concrete a small batch mixer is recommended as most satisfactory, the materials to remain in the mixer at least one minute.

Where the system of forms is such as to require the removal of the forms immediately after pouring the concrete, a dry mix is permissable, if the concrete is thoroughly tamped into the forms—the exterior of such a wall to be finished with stucco. Concrete shall be protected against freezing until it has hardened for at least ten days in a temperature not less than 50° F.

Backfilling is to be governed as follows:

(e) Backfilling on the outside of basement walls shall not be done until at least 75% of the dead load of the superstructure has been placed upon the walls. Backfilling shall be placed in layers and rammed and no large lumps or stones shall be used.

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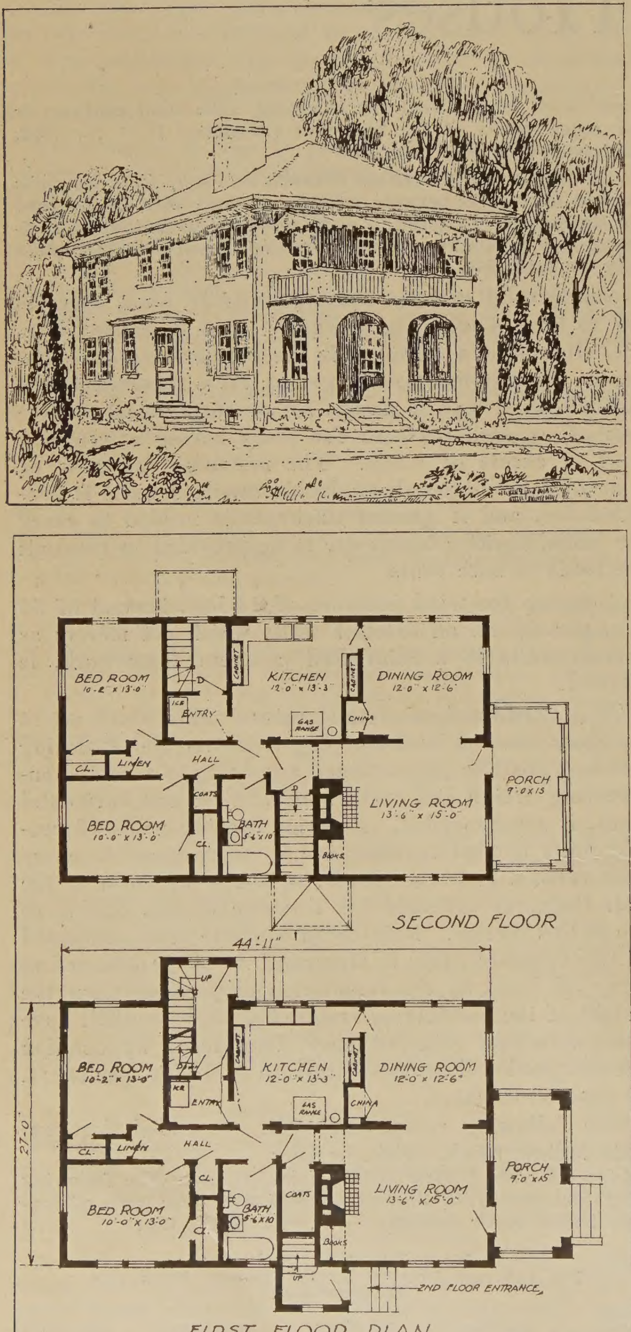

Fig. 1—Perspective and Floor Plans of Guncrete House

Experiences of Builders of Reinforced Concrete Houses

Miss Kate Gleason, builder, Rochester, N. Y., gave an interesting talk to a very attentive audience, on her methods used in constructing and selling concrete houses. The original methods used, and their modifications, which experience with the first houses indicated were essential, were outlined in a manner that gave the audience the benefit of a knowledge gained in building about 80 houses. As all the construction methods and details used by Miss Gleason in house construction have been described in CONCRETE in January, 1921, and January, 1922, the information included in her address is not repeated here.

D. S. Humphrey, Cleveland, in discussing Miss Gleason's work, described his methods used in building concrete houses for summer use at Euclid Beach Park, Cleveland. This has been considered in previous issues of CONCRETE.

* * *

A Guncrete House at Watertown, Mass.[1]

By H. Whittemore Brown

A concrete house has recently been constructed in Watertown, Mass., that is the result of considerable research on the problem of constructing a house which would combine as many of the following principles as possible:

1. Maximum protection from the elements.
2. Economical use of materials.
3. Indestructible by fire or elements.
4. Attractive interior surfaces.

The result of this research is the system of construction which has been termed guncrete, because of the combination of gunite and concrete.

The floor plans and perspective elevation of the Watertown house are shown in Fig. 1.

The walls are made up of an exterior covering of approximately 1½ in. of gunite, supported by wire or expanded metal reinforcing, and attached to a poured concrete frame. This frame is made up of sills, studs, and girts, somewhat the same as in braced-frame wooden construction.

Between the concrete studs there are light wooden panels which have waterproof burlap or tarred paper next to the gunite, and wooden laths on the inside as a support for interior plaster.

At the studs the inside of the concrete is covered with tarred paper, and metal lath nailed to the wooden panels on either side, and covering the space between the panels. The whole interior surface is plastered in the ordinary manner. Thus every portion of the interior plaster is insulated from the exterior concrete by tarred paper and by an air space. This air space is about 6 in. between studs and about a quarter of an inch at the studs.

The floors are similar in principle to the exterior wall; burlap covered panels support a poured slab, while the space between panels forms the stem of a T-beam. The plaster is insulated from the concrete of the floor in the

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[1] Abstracted from a paper presented before the Annual Convention of the American Concrete Institute, Cleveland, February, 1922.

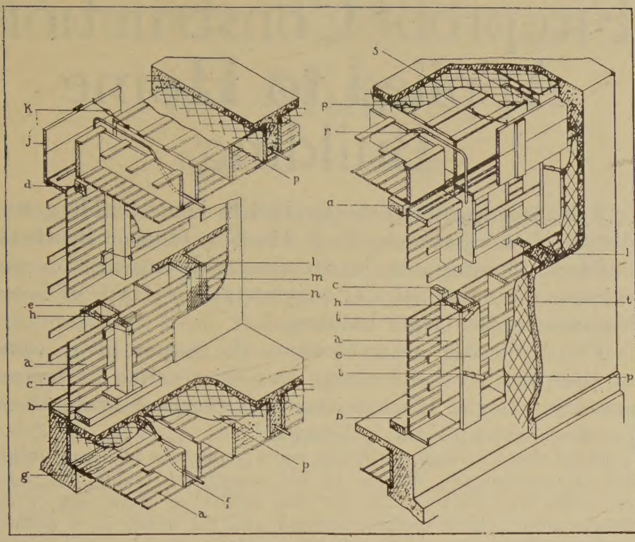


Fig 2 Fig 3

Figs 2 and 3—Drawings Illustrating the Principal Elements of the System

same manner as in the walls to eliminate any possibility of staining.

The interior partitions are of non-bearing wood stud and lath construction; all the interior load is carried on concrete girders and columns.

The roof is made of wood, with plates anchored to the concrete of the third floor. The covering is asbestos-backed asphalt shingles. A wooden roof was used on this house because the third floor was not required for rooms, and a hip roof was necessary only for appearance and for insulation. With the exception of the roof, every structural member of the house is made of concrete. Wood is used only where protected from fire and moisture by concrete or asbestos. Even if the roof should get afire, the contents of the house would be protected by the concrete third floor.

The house is finished with ordinary wooden trim nailed to the wooden panels. In the lower apartment wooden top floors are nailed to the concrete, excepting in the kitchen and bath, where linoleum is used. The upper apartment has linoleum floors throughout, glued directly to the concrete.

The fireplaces are finished with a brick facing built against the concrete. The chimney is concrete, made with terra cotta flue lining as a core, and Metaforms for the outside form. A wooden buck forms the fireplace openings.

As the house is practically air tight, hot air heating is used. During the recent cold weather, there was no difficulty in heating every room.

The principal element of this system is the permanent wooden panel, *a* Figs. 2 and 3, made of 1 in. by 6 in., or 1 in. by 8 in. boards, which has wooden laths nailed on one side and a backing or form *p* for gunite or concrete on the other side. During construction these panels were held in place by a temporary frame, which is made of wood, and consists of sills *b*, studs *c*, plates *d*, and outside boards *e* for the walls, and beam bottoms *f* for the floors. The permanent panels are placed between the studs or the beam bottoms, leaving a space for steel *r* and concrete.

When the span is long, an extra line of sills, studs and plates is necessary to prevent excess deflection of the panels under the weight of the green concrete.

The method of erection is as follows:

The floor panels are first placed on top of the foundation wall, as shown in Fig. 2. They are supported at the other end by the forms for the central girder. The 1 in. board *f* which forms the beam bottom is supported by the temporary plates *d* and by temporary battens nailed to the panels. A form is placed around the exterior of the building for the water table and concrete sill. Reinforcing is put in the beams and sufficient concrete poured to fill them. The slab reinforcing *s* is then put in place and the slab poured. The slab may be of ordinary concrete or nailing concrete, depending upon whether the finished floor is to be linoleum or wood.

As soon as this concrete has sufficiently set to walk upon, the first story is started. First the temporary sill *b* is placed around the edge of the building on the line of the interior lathing. The studs *c* are then put in place; the cap *d* is put on top of the studs, and forms the line for the ceiling laths. This temporary frame is trued and braced. Loops of wire *b* are attached to the temporary studs as shown in the illustration.

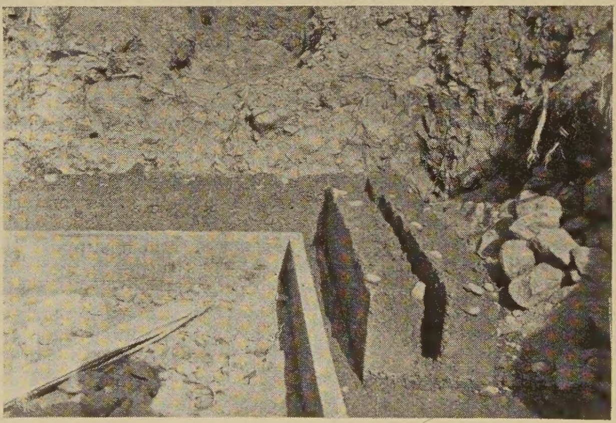
In erecting the panels it is best to start at the corners and place the two corner panels in position, and hold them with two outside boards which have been nailed together at right angles. The loops of wire are passed through the outside boards asd sticks inserted in the loops. When the sticks are twisted the outside board is drawn against the panels, making a tight fit.

Proceeding along either side, the outside board is put against the other side of the corner panel, and loops of wire put through the holes in this board, and the sticks *i* inserted in the loops. The next panel is then slipped in between the temporary stud and the outside board. The sticks are then twisted, drawing the outside board tight against the panel. The process is continued around the building until all the panels have been put in place.

The second floor panels are now placed in the same manner as the first floor panels. The bottom of the form *j*, for the girt around the second floor, is nailed to the top of the first story panels; the top is wired to the second floor panels *k*.

The studs *l* are now ready to be filled with concrete. After the concrete in the studs has settled sufficiently, the second floor is poured in the same manner as the first floor.

Succeeding stories are constructed in a similar manner.



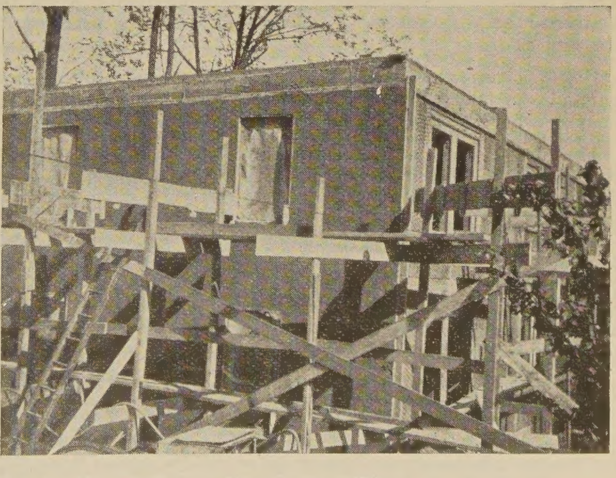


Fig. 4—Beginning of Foundation Wall

Fig. 5—Second Story Panels Partially in Place

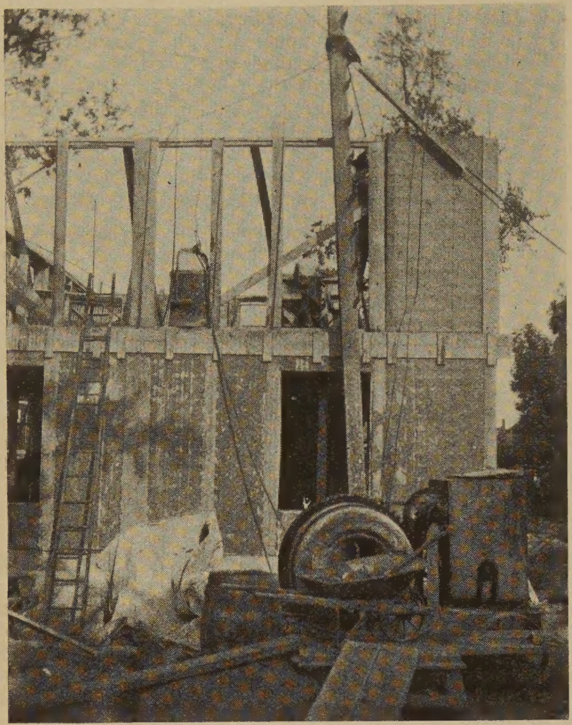


FIG. 6—POURED CONCRETE IN PLACE AND GUNITE ON ONE WALL

After the concrete has hardened, the sticks are removed from the loops of wire and the outside boards pulled off. The inside of the loops of wire are cut and the temporary frames removed. The reinforcing mesh for the exterior is placed in position, and the loops of wire bent up to hold this reinforcing in place. When the gunite *t* is applied a perfect bond is obtained between the gunite and the poured concrete, thus increasing the tie between the reinforcing and the concrete frame.

Before plastering, a heavy tarred paper *m* is put in the recess of the studs and strips of metal lath *n* are nailed to the panels on either side.

In constructing the Watertown house the floor and wall panels were covered with waterproof burlap. This material worked pretty well as a support for the 2-in. floor slab. There is some sagging between the cross pieces, which support the burlap, but this sagging increases the effective depth, and consequently the strength of the slab. Some difficulty, of course, was encountered in pouring the floor, because care must be exercised by the workmen in order to avoid stepping upon the burlap between the supports. However, the few accidents which occurred were easily remedied, by covering the holes with another piece of burlap.

Fig. 4 shows the beginning of the foundation wall, using the Universal hollow wall molds. These molds were used up to the first floor.

Fig. 6 is an exterior view, showing the second story panels partially in place, and Fig. 5 shows the building with the poured concrete in place, and gunite on one wall.

The direct cost, not including overhead or other indirect charges, of the parts of this house which are unusual was as follows:

1. Foundation and cellar wall 56 cu. yds. at $18.00	$1,007.35
2. Floors, not including wood or linoleum top floor 3762 sq. ft. at $0.498	1,874.93
3. Exterior wall, not including plastering 3177 sq. ft. at $0.585	1,858.98
4. Roof, including plates, rafters etc. 16.42 squares at $38.20	628.10
5. Chimney	245.95
a.—2 fireplaces at $42.25 each	84.50
6. Interior partitions, without plaster 2981 sq. ft. at $0.195	581.35
7. Plastering 1318 sq. yds. at $0.593	781.20
8. Wooden top floors 975 sq. ft. at $0.204	199.00
9. Linoleum top floors 127 sq. yds. at $2.66	338.20

Fireproof Construction Applied to Home Building

Reinforced concrete as applied to home building was discussed in a paper by P. J. Hueber, Hueber Brothers, builders, to bring out the architectural, engineering and commercial possibilities of concrete for any type of home the same as for larger buildings.

The following abstract from the paper gives some of the principles underlying the construction of houses according to the Hueber plan. (Described in detail in previous issues of this magazine.[1])

Sifted down to essentials, the use of concrete in home building is economically limited to the structural frame, the cost of which will be identical for two homes of same size, even though one is in a wealthy section and the other in a poorer section—the structural frame being determined by the desires and purses of the people for whom they are built. So as far as concrete is concerned, the problem is one of economically producing a structural concrete frame for a home that will not crack when properly reinforced, which fire cansot burn, that time cannot fade, that rain cannot penetrate, that winds cannot budge, and which vermin cannot disintegrate. This concrete frame is naturally determined by the forms into which it is poured when in a plastic state.

There certainly is so reason why we cannot also finish a concrete frame as we do a wood frame, with various architectural results. The form for a job requiring walls and floors consists primarily of a sill course, studs, plates and floor joists, all sheathed over and properly fastened and supported. Fundamentally, these forms are nothing other than our typical structural parts used in framing a wood house, without cutting for windows and doors.

It is very evident then that before we pour our concrete for a building, we must practically erect an ordinary wood frame for our structure, as a form from which we will obtain a duplicate in concrete. Therefore, since it is apparently a matter of covering our present wood frame with a concrete frame, and then removing the wood one, the study of the forms for so-called concrete house brings us back to the study of the structural elements of ordinary wooden house framing, to see how they can be adapted for standardized forms for obtaining a duplicate frame of concrete of various sized plans.

The architectural success of wood homes cannot be questioned, as there are thousands of examples to prove it a fact, and all we want to do is to duplicate the unseen structural wood frame with an unseen structural concrete frame; finishing it the same, if you wish, with clapboards, stucco or brick, and a roof. In veneering with brick we build our cellar walls thicker up to grade, to form a ledge to start our brick, which we keep one inch from concrete wall, which air space saves furring.

Hueber forms are offered to solve the problem; a description of them is simply a description of recognized form work, which in turn is the structural frame for a wood home. We combine both wood and steel in our forms, and have simple ways of connecting the standard parts of the frame so they can readily be erected, braced and taken down for re-use.

These forms and their use have been described in CONCRETE.

* * *

Ingersoll System Monolithic Houses

Construction of a group of monolithic houses at Phillipsburg by the Ingersoll system, for the Phillipsburg Development Corporation at Phillipsburg, was described in a paper prepared by Paul R. Smith, architect and town planner, who has been in charge of the operation. This paper, due to Mr. Smith's absence and the fullness of the evening's program, was presented by title and will appear in the Institute Proceedings. It contains a detailed analysis of the cost of the various operations in the erection of the Phillipsburg concrete houses.

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[1] CONCRETE, January, 1921; January, 1922.

Concrete Tile Houses for Miners[1]

By Barton E. Brooke

As architect for the Youngstown Sheet & Tube Co. since 1917, I have had experience with two distinct types of concrete houses. One, constructed under the so-called Unit system of precast concrete slabs, a development in East Youngstown, Ohio, comprises 281 houses. This work was started in the fall of 1917 and completed in the spring of 1920. Most of you are, no doubt, familiar with this operation, as it received wide publicity through the magazines[2] and the contractors, the Unit Construction Co. of St. Louis, and I do not intend to go into detail on their construction. However, it might be of interest to know that these houses have stood the test in every way, the only exception being the appearance of condensation on the concrete walls when first occupied after vacancy during a cold period.

It might be explained that the outside walls of these houses were cast with exterior face of finished concrete, and 1 in. x 2 in. creosoted wood furring on the concrete ribs in the interior, on which wood lath and plaster were applied. Whereas we felt it necessary to use this form of construction on the outer walls, we considered it safe to construct the inside partitions of hollow concrete units, with finished face of concrete both sides. These walls have given the trouble. Over periods as long as two weeks after occupancy, moisture has condensed on them, while no condensation has ever occurred on the outside walls. From this experience and others, I strongly advise that for rental houses at least, where vacancy is bound to occur, it is unsafe to use exposed concrete slabs or to plaster direct on any type of masonry walls. In every other respect, however, these houses are highly successful. No sign of depreciation of the structure is apparent and they receive the hardest kind of usage from foreign-born tenants.

At the same time, work was started on the unit concrete houses in East Youngstown, we started the development of a coal mining town at Nemacolin, Pa., for the Buckeye Coal Co., a subsidiary of the Youngstown Sheet & Tube Co., in which the houses were to be rented at maintenance cost, depreciation and interest being charged to the coal mined. They were modern in every respect, of five and six rooms, bath, and concreted cellar, with hot air furnace, equal to the houses of well paid workmen in the cities, and not at all like the usual miner's house, which is of four rooms, hardly more than a shack, without basement, plumbing, or heating, other than an open grate, and kitchen stove, and which rents for $5 or $6 per month. The rental of our houses was placed at $10 for the five-room and $12 for the six-room type.

As rentals of this amount were double the usual rate, and houses of this type were new to the miner, many experienced coal mine operators laughed at what they considered the folly of the scheme. They predicted all manner of misuses of the conveniences, and failure to get miners to come to the town at the relatively high rent. This, however, did not prove a fact in either case.

On the contrary, the company has never been without a large waiting list for houses from miners who wanted to work and live in the town, even during the war days, when every one was short of labor. Men came with their families and lived in camps for months, waiting their turn to get houses as they were completed. With very few exceptions, plumbing and heating fixtures have been well cared for and greatly appreciated. This condition enables the employers to pick their men carefully, and today they feel that there is not a better manned mine in the country. The tonnage produced per man is far greater than in any other mine in the district, and the labor turn-over and lost time is almost negligible. Through one strike in the district, and several decreases in wages, they have not had the least trouble, working continuously every day. I mention these facts to emphasize that it is a paying investment to build modern houses, no matter what class of people are to occupy them, or to what they have formerly been accustomed.

Due to early transportation difficulties, these houses were planned with frame superstructure and monolithic concrete basement walls. Tonnage hauled to the town site was the most important factor of cost, as it had to be ferried across the river from the railroad and up a steep incline to the top of a hill at an elevation of 400 ft. above the river bed. Soon after starting work it was discovered that the average five-room house, as planned, would cost something over $8,000, and every effort was made to reduce that expense. The design of the house was simplified, and the foundation walls changed to terra cotta tile. These changes helped considerably, but the tile foundation was homely and by no means waterproof. From the start I have been searching for some form of construction for the houses which would be economical under existing conditions and at the same time give us strength, appearance, waterproof foundation and fireproof superstructure walls, but nothing was found until, while attending the National Conference on Concrete Housing in Chicago, two years ago, I learned of the hollow concrete tile, which I felt would solve our problems. I therefore returned to Youngstown, and designed houses for the use of tile in our future operations. This was not a difficult thing to do, as the units we intended to use could be made to fit any condition, and all that was necessary was to retrace the already accepted design for frame houses, simply increasing the thickness of the walls and changing the dimension accordingly. After prevailing upon the company to purchase machines, and erect a plant to manufacture the tile; we selected our site, which was not an advantageous one, but the only available space in our railroad yard layout.

Erection of the plant started in April. Our engineers had worked out an excellent arrangement of the machinery, in a tall frame structure at the top of which large bins were constructed for sand and cement, with batch measuring device at the hopper, which dumped directly into the mixer. The mixer in turn dumped directly into a hopper, which connected through a chute to the tile machinery. The bins were supplied with sand and cement by bucket conveyors, which together with mixer and tile machines were driven by electric motors. This arrangement was all that could be hoped for, but because of the fact that the plant site was on the uphill side of the railroad, it was necessary to erect a derrick with clamshell to unload cars of sand and place it at the foot of conveyors. Had it been possible to unload cars by gravity, this expense would have been eliminated. As it was necessary to have steam to cure the tile, a line was run from the mine power plant and used to operate the derrick through a steam engine. Five curing rooms, about 9 ft. wide and 5 ft. long, were built adjacent to the plant, with walls constructed of the first tile produced and reinforced concrete roof. Steam was piped to water sumps in each curing room. In these the newly made tile were placed and when full they were sealed so that the enclosed oxygen was completely saturated when the steam was turned on. Under these conditions the tile were left for 24 hours before being placed in the yard to dry.

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[1] Abstracted from a paper presented before the Annual Convention of the American Concrete Institute, Cleveland, February, 1922.

[2] See Concrete, January, 1918, and January, 1919.

An average of twenty-four hundred tile were produced on each shift, under favorable conditions, from one machine with nine men. With a four-machine plant it is possible under favorable conditions to produce, with an average of five men, the same number of tile from each machine.

We were in operation by June 1, but at first our production was slow, due to inexperience of the men. However, the product was excellent, and gradually the cost was reduced, until the tile were being manufactured at about the same price at which terra cotta of the same size could be purchased.

The tile were made with small corrugations on the outside face to receive stucco, and smooth on the inside. We had already discovered the bad results of plastering directly on masonry walls, and intended to use furring, wood lath and plaster on the interior.

By July 1 we had a sufficient number of tile made and cured to start construction, only to find difficulty in getting masons, even at $1.50 per hour and board. Mason contractors submitted prohibitive prices to lay the tile, due to their lack of knowledge of them, and we were forced to abandon our ideas of fireproof structures, returning to the frame with foundations and cellar walls of concrete tile. A total of 60 two-family houses of this type were completed during 1920 and 1921, together with an amusement building containing billiard rooms, bowling alleys, and motion picture theatre, seating 550 people. This building is the only one to date built entirely of concrete tile. The basement walls were constructed of 12-in. concrete tile, faced with 4 in. of brick and the superstructure of 12-in. tile and stucco. The labor costs on 12-in. tile walls was 15c per cu. ft., with masons at $1.50 per hour, and labor at 80c, and stucco was applied in two light coats, giving perfect results, at a cost of 50c per sq. yd., as against $2 per sq. yd., the price at the time for stucco on terra cotta tile. These are remarkably low costs for the time, and at least so far as the mason labor is concerned, should be cut in half today. I do not believe there is a building unit made, which can be handled and laid in a wall at lower cost than these tile, and I am sure that there is no base for portland cement stucco that compares with it in any way. The wall and the stucco, being of the same material, all difference in expansion and contraction which generally cases cracks in stucco, is eliminated, and the wall is so straight and plumb that two light coats of stucco give perfect results, without the usual screeding and darbying required on more uneven surfaces, hence a saving of both labor and material is made.

The house foundations were equally successful. They were covered with stucco and waterproofed below grade with perfect results. The walls were 8 in. thick and laid at a labor cost of 10c per sq. ft. of wall surface, and plastered at 50c per sq. yd. The completed foundation was amply strong for a two-story house, and constructed at one-half the cost of monolithic concrete, as well as giving a better appearance.

At the close of our operations last fall we had manufactured a total of approximately 300,000 5 in. by 8 in. by 12 in. tile, and completed in all 275 homes, or about one-half of the ultimate town. The advantage of such a house is obvious, in its comparative safety from fire, permanency and low maintenance expense, and, I believe, that under favorable conditions of manufacture and labor it will not exceed a frame house in cost.

* * *

Research

As chairman of Committee E—3, Research, Prof. W. K. Hatt presented a survey of more than a hundred titles of research which is being undertaken by various agencies and of research for which there is need.

Two papers were read by Professor W. K. Hatt, "Ball Test Applied to Concrete" and "Fatigue Tests of Concrete."

In the discussion of ball tests, the possibility of further investigation as to the effect of hardeners on such tests was suggested. In making fatigue tests on plain concrete an average load of 50% of the ultimate strength was used, the range being from 40% to 80%. Reference was made to both these tests in CONCRETE for February.

* * *

Flexural Strength of Plain Concrete

A paper was presented by Duff A. Abrams on the flexural strength of plain concrete, including the results of an elaborate series of tests. In discussing the results the facts were brought out by Prof. Abrams that the modulus of rupture of plain concrete is about 20% of the compressive strength, with variations due to other causes, and that the strength of concrete increases as a logarithmic function of the age. In specimens with over 1½% of steel, failure is by shear or bond, rather than by tension of the steel.

Tests were referred to by W. A. Slater which indicated that concrete specimens reinforced with .18% to 0.2% of steel failed at the same loads as plain concrete.

In the general discussion following, the importance of moisture content of concrete in road work was emphasized, the drying of the specimens having been found to produce marked changes in the strength. The fact that road engineers feel that the condition of the specimen do not duplicate actual conditions was mentioned, and it was cited that the loss of strength due to excess water is permanent. The cement particles are dispersed by water and as more water is added the point is approached where the cement particles will not adhere.

* * *

Report of Committee E—7: Waterproofing

Committee E—7 on Waterproofing, S. C. Hollister, chairman, submitted merely a partial program as a progress report. This was done by J. H. Libberton, secretary of the committee. With a view to consideration of each subdivision of the subject, the following subcommittees have been appointed:

1. Integral methods and plaster coatings.
2. Penetration surface applications.
3. Bituminous coatings and membraneous systems.
4. Non-bituminous surface coatings.
5. Waterproofing concrete.

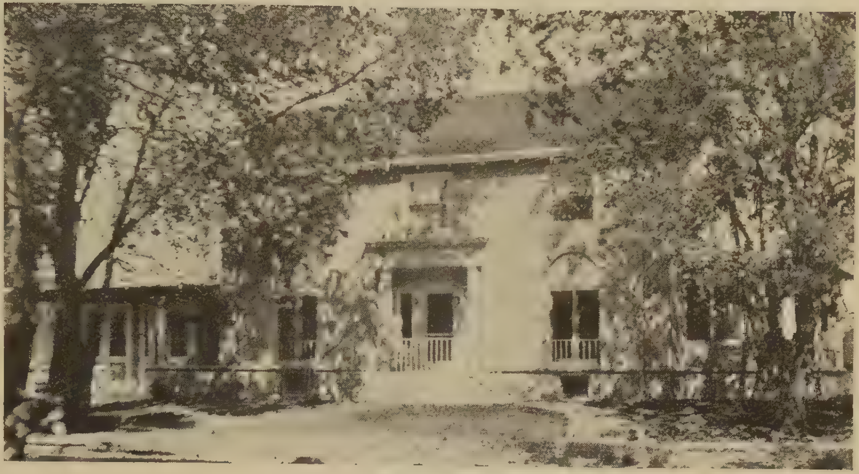
The committee will have a definite construction report ready for the next meeting of the Institute, and it is aimed to clear up some of the misunderstandings which seem to exist on the subject of waterproofing.

[Continued on Page 129]

My Own Concrete House

Built of Faced Block and Trim Stone

By A. J. R. Curtis
Chicago



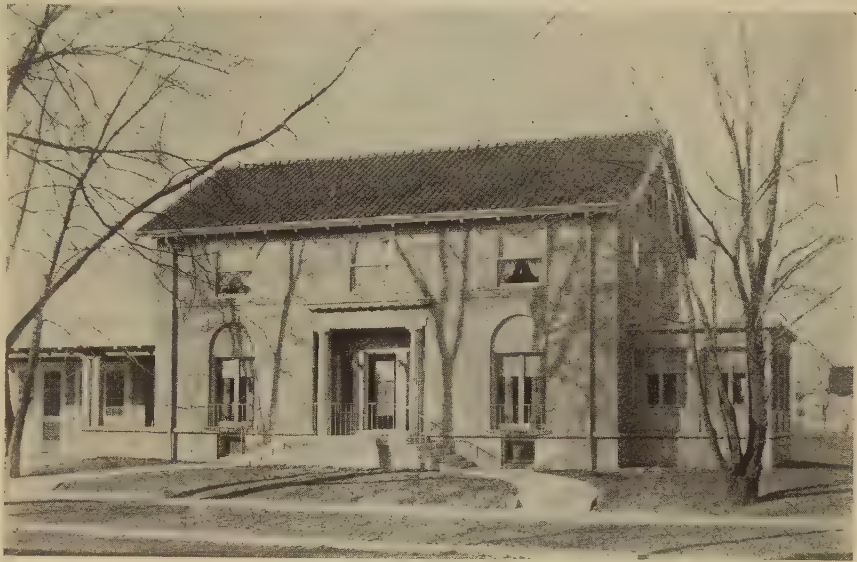


Fig. 1—Residence of A. J. R. Curtis, Oak Park, Illinois—Henry K. Holsman, Architect — Built of Concrete Block and Concrete Dimension Stone—The Upper View Taken Early in the Fall of 1921, Shows a Good Setting—The Other View, with the Leaves Gone, Gives a Better Idea of Details of the House

The residence described in this article has walls constructed entirely of Hydro-Stone concrete block, laid in portland cement mortar. Double-wall Hydro-Stone construction, with continuous air space, was used for the basement and first story walls, as well as for all of the basement partition walls. The two-lug single wall type of Hydro-Stone was used for the upper walls of the house, and the entire walls of the garage. The basement walls rest on a monolithic footing 24 in. wide and 16 in. deep, on "hard pan."

Block used below grade and for the inner wall of the first story are of the flat surfaced variety, without facing, while all of the exterior exposed block and the interior block in the sun room have flat granite surfaces, buff in tone. These exposed block were faced with a mixture of buff sand, white marble, granite, mica spar and buff ironoxide, producing a shade resembling buff Bedford stone when viewed at a distance and a rich granite texture when seen at close range. Above the water table red mortar color was used in the mortar, to produce a pink tone, contrasting mildly with the surrounding block.

Wall thicknesses vary somewhat, but form striking contrast with the exceedingly thin light walls, so commonly used in the frame and frame and stucco houses of the day. The main walls of double construction have a thickness of 12 in. of block plus ¾ in. of plaster. Partition walls of the same construction have a thickness of 8 in. or 10 in., with plaster thickness in addition. Second floor and garage walls are 7½ in. thick from surface to the inside tips of the lugs, while the main body of the block has a thickness of 2½ in. These walls finished, with furring, lath, and plaster, have a thickness of about 9 in.

Normal full-sized units have face dimensions 9 in. by 24 in. These were used for all of the straight wall work, but the modest use of special art stone units of the same color and texture as the block was depended on for the wall decoration. These special units consist of the sills, lintels, columns and other pieces used in forming attractive water table and belt courses, window arches and the front entrance. Over 6,600 units were required for the job, having a total weight of about 170 tons, an average of 51 lbs. per unit. The lightest piece weighs about 12 lbs., and the heaviest, a lintel supported by the two large columns at the entrance, weighs about 2½ tons. These columns weigh approximately a ton each. A few other pieces exceeded 1,000

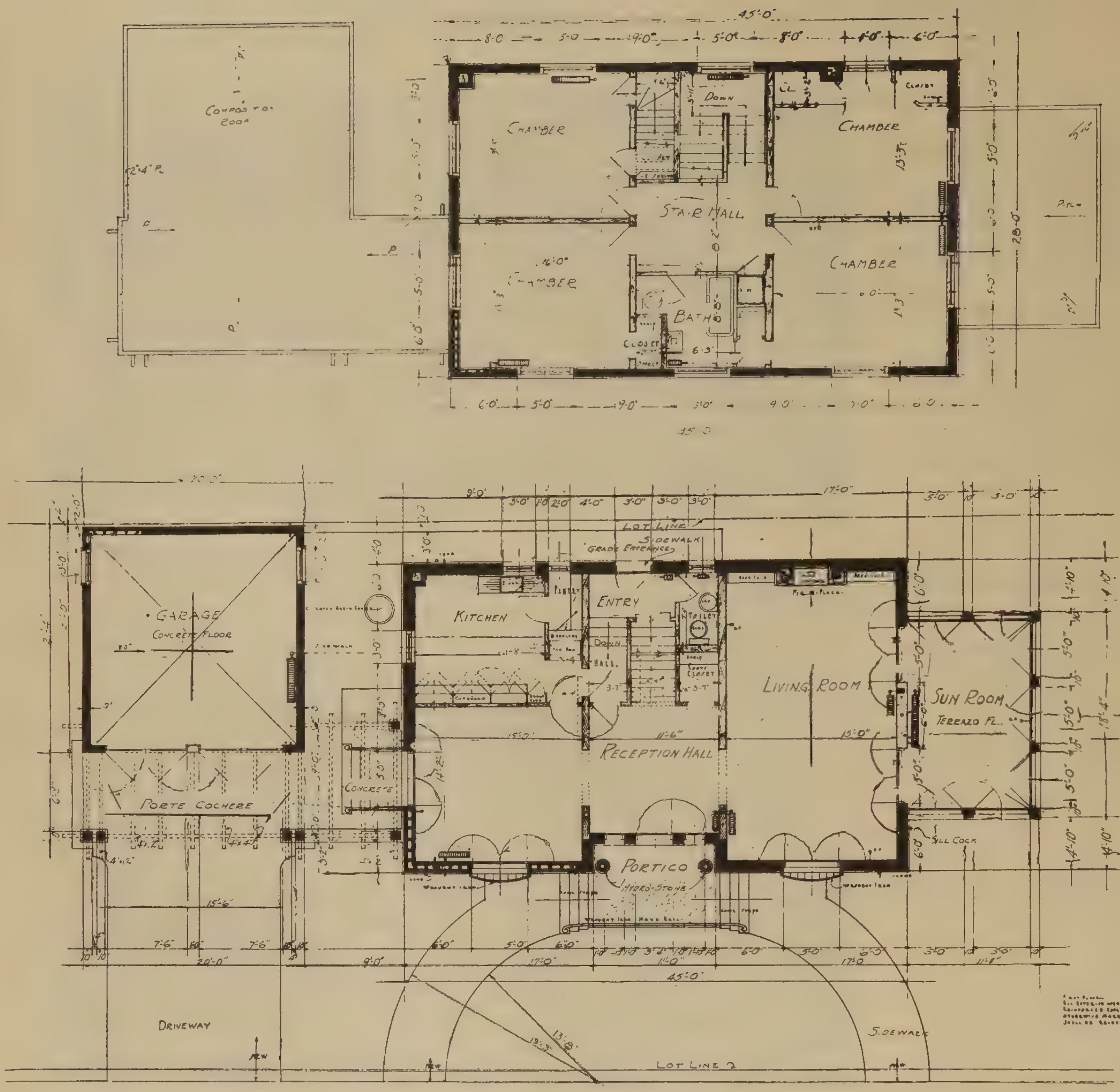


Fig. 3—First and Second Floor Plans

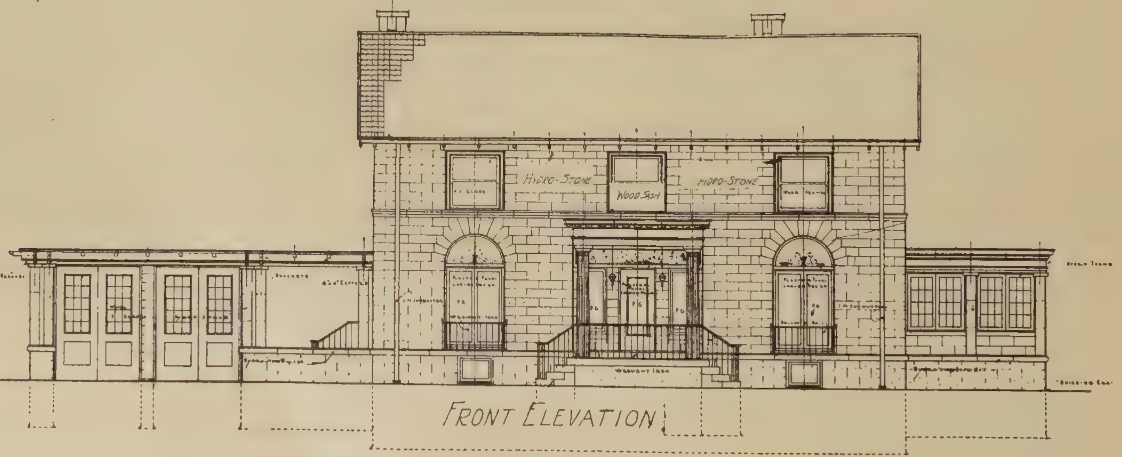


Fig. 4—Front Elevation

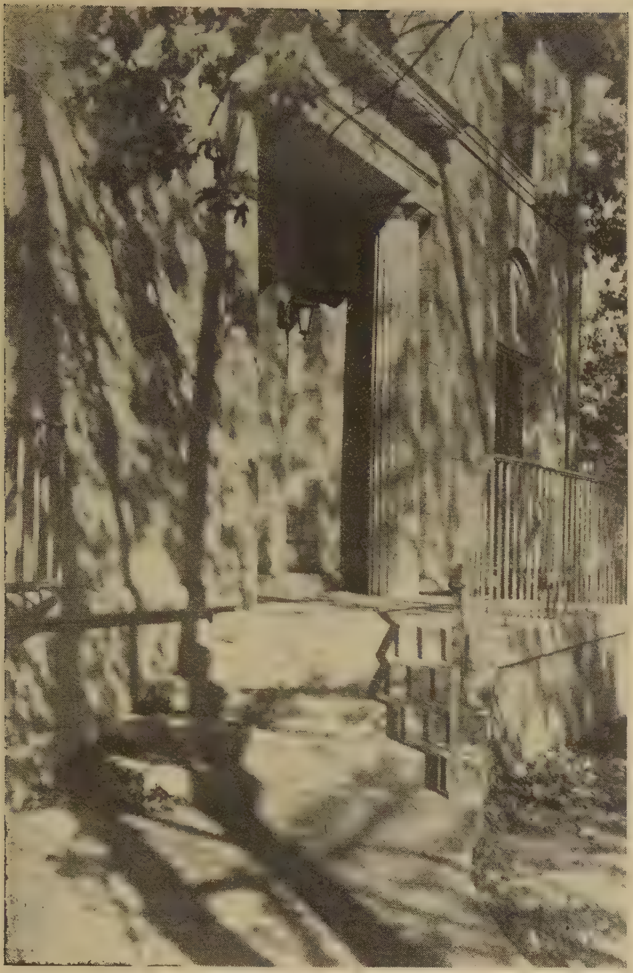


Fig. 2—An Interesting Detail of the Entrance—Steps Are Finished in White Cement, Granite and Buff Oxide, Matching the Block Walls

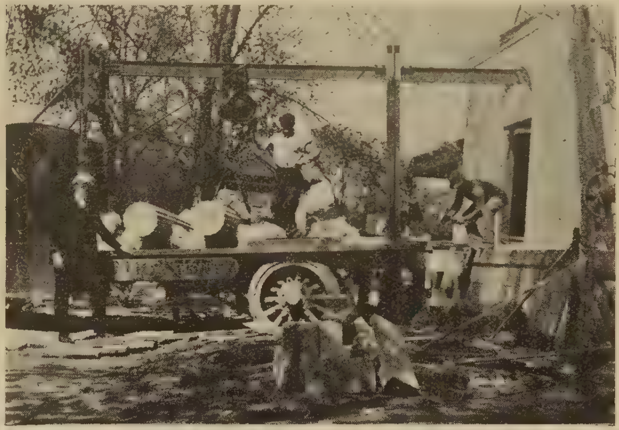
lbs. in weight, but all were so designed that they were handled with comparative ease.

Hydro-Stone block and art stone were furnished by the Hydro-Stone Products Co., Chicago, and delivered to the site of the building, 15 miles distant, by motor truck. Handling of the units was greatly expedited by the steel crane equipment with which this company's trucks are fitted. The block and smaller art stone units were packed at the plant on large frame pallets, 4 ft. by 6 ft., and these were conveniently loaded by means of the truck cranes and unloaded on the job in the same manner. The larger units were fitted with steel lifting rings and were loaded and unloaded individually. The heavier pieces were trucked to points from which the truck crane could lift the units into the reach of the job derrick. All of the block and trimstone were carefully padded with excelsior. Not a single unit was broken or injured in trucking or setting, and the details were so well planned by the architect and the Hydro-Stone company that it was not necessary to cut block or supplement the concrete units in any way.

In design the structure would be classified as a modern colonial residence. Henry K. Holsman, Chicago, who has had quite a distinguished record in the design of structures of concrete units, is the architect. The main plan is a simple oblong, with sun room added at one end, balancing the garage on the other.

The principal decorative feature is the front entrance, using two doric columns 17 in. in diameter and 9 ft. 6 in. high, supporting lintels and other decorative pieces with a combined weight of about 6 tons. The columns and the pieces they support rest on a reinforced porch floor slab supported on the building walls and on a special footing. Porch floors and exterior steps are all surfaced with the same mixture as used in the face of the block, producing a decidedly rich and pleasing effect. The use of wrought iron balustrades, hand rails and window baskets on the exterior adds a considerable air of distinction. In order to give the entrance as much depth as possible, the columns and lintels are depressed into the wall and the portico is reached by duplicate flights of steps and walks laid on a circumference.

A number of small square columns were used to support the trellis and roof extending from the west end of the residence, across the front of the garage, and similar columns were also used to panel off the sun room walls and give them something of the enclosed porch effect. Contrary to the usual condition in residence construction, the chimneys help the building architecturally, rather than constitute a blemish. They are both constructed (above the roof line) of special "L" shaped units, two to a course. These units are slotted vertically, to give a simple design on each face of the



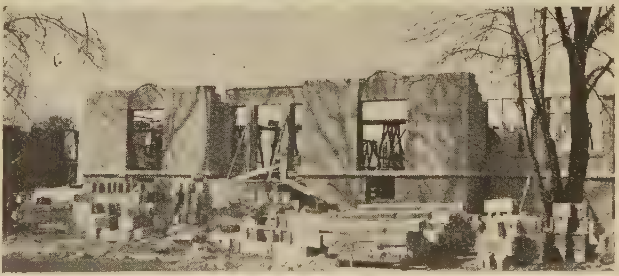


Fig. 7—Method of Moving the Heavier Pieces from the Truck by Means of a Truck Crane, Which Conveys Them Directly to the Mason's Derrick

Fig. 8—The Foundation Is of Plain Block Laid Up in 1:2 Cement and Sand Mortar—It Rests on a Monolithic Footing 24 in. Wide and 15 in. Deep—The Block Joints Were Made Flush and the Exterior Surface of the Wall Is Not Coated in Any Manner

Fig. 9—South Walls Erected to Second Floor Level, Showing Pleasing Effect of the Heavy Semi-Elliptical Water Table Course

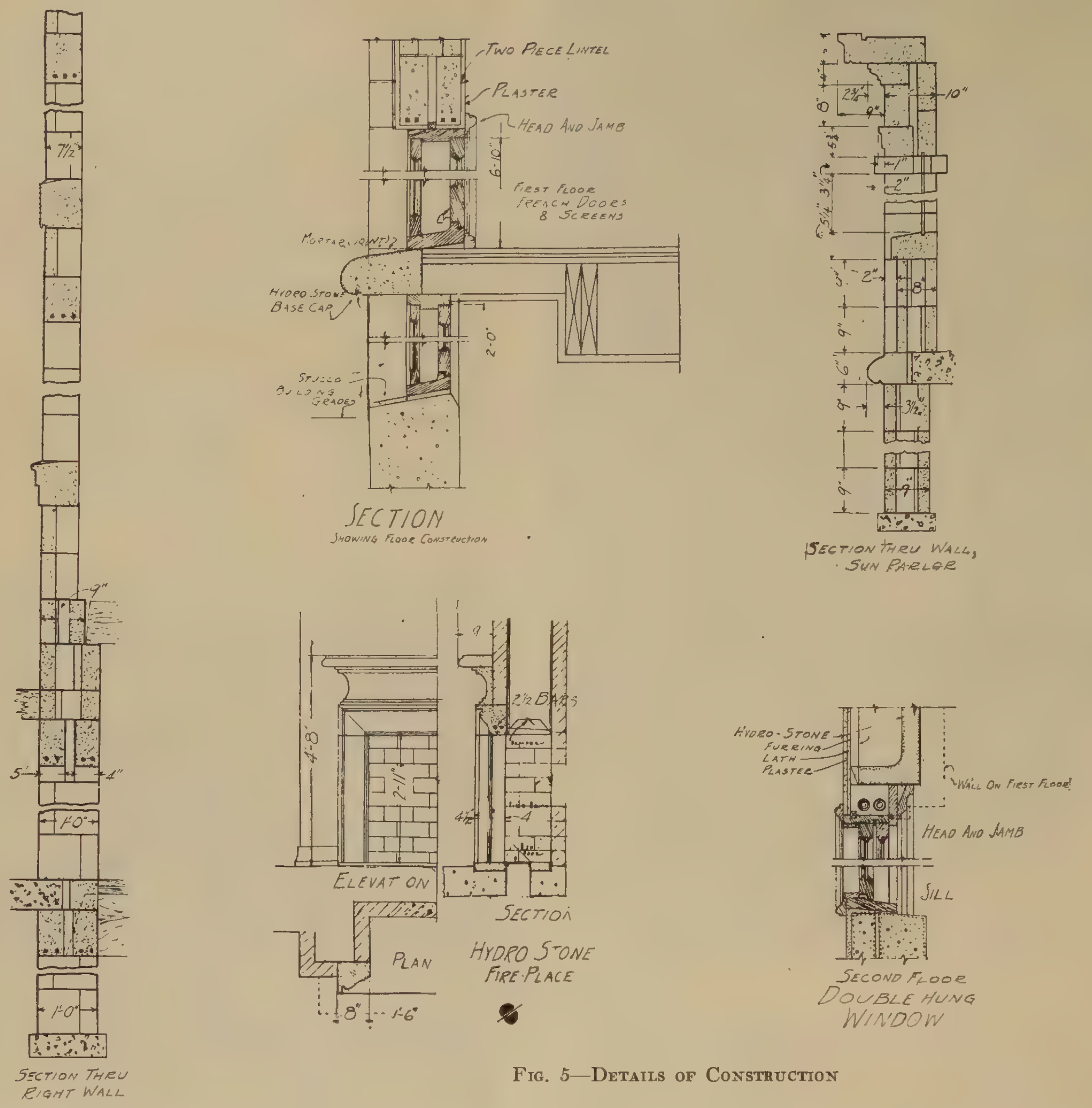


Fig. 5—Details of Construction

chimneys. Both chimneys are topped with plain flat overhanging caps.

Accompanying plates show laying diagrams furnished to the contractor, Walter J. Johnson, of Chicago, and used by the masons in laying up the south and west walls. Similar diagrams were furnished for the entire job. All pieces except the standard block were carefully numbered to correspond with numbering placed on the laying diagrams, in the same manner as for dimension stone.

In most localities concrete units of this kind are laid up by either stone or brick masons, the two craft usually having concurrent jurisdiction. On this job the work was done by bricklayers, who professed to know the stone mason's trade as well. After the job was well under way the speed of laying was at least 50% faster than for an equal volume of common brick masonry, notwithstanding the very high character of the pointing and the regular and true surfaces required. The masons worked somewhat slower, or a little more labor was required than would have been the case had lime mortar been used. Cement mortar, without the addition of lime, was used throughout, necessitating mixing in small batches, rather than in one large bed, as with lime mortar. At the conclusion of the job it can be said that cement mortar has abundantly justified its use, the superior strength and durability being worth many times the small additional cost.

In mentioning construction details, the subject of water-tight basement deserves a few words. The excavation was made almost entirely in hard pan, the hole around the basement walls forming a cup for the retention of surface water. Under these circumstances it was our intention to plaster the outside of the walls with rich cement mortar, and tile around the footing in the usual manner. However, an inspection of the wall, laid with perfect flush cement mortar joints, led to the belief that it would prove entirely water-tight without the customary precautions.

Before the backfill was made we had a cloudburst, which filled the excavation with water almost up to the grade line, the water remaining for several days. This condition gave ample opportunity to test the water-tight qualities of the wall, and we were greatly pleased to find, as had been expected, that the interior of the wall was as dry as a chip at all times. Our experience in this regard is not given to encourage abandonment of the usual exterior treatment for masonry walls below grade—cement plaster coat and tiling—but simply to show that where the wall is just ordinarily well con-

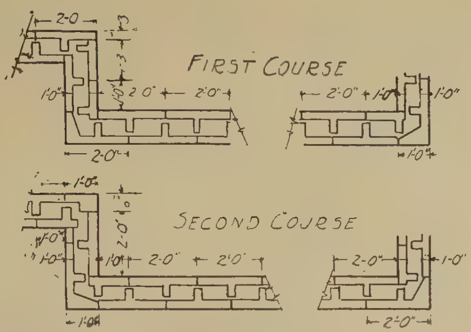


Fig. 6—A Partial Laying Plan — Such Drawings Were Made for the Entire Job

structed, it will not admit moisture. Where there is the slightest doubt, the plaster coat and tiling around the building are well worth while.

With the exception of the Sun room floor, and the area immediately above the heating plant, which are 7-in. reinforced concrete slabs, the floors throughout the first and second stories are of the usual frame construction. Two by 12-in. floor joists were used throughout, being supported directly on the inner block walls. Plaster was applied directly to the inner block on the first floor and to metal lath on the ceilings. Wood lath was used on interior wooden partitions. It is noteworthy that no cracks whatever occurred in the plaster placed on the block or metal lath, while considerable cracking occurred in that placed on wood lath. If the building were to be built again, no wood lath whatever would be used. The second floor walls, which are of single-wall hydrostone construction, carry furring, lath and plaster, placed in the same manner as for any other type of masonry construction.

The main roof is of red tile on heavy framing, and the gutters of wood, lined with seven-ply asphaltic paper. Roofs covering the sun room and garage are of composition tar and gravel.

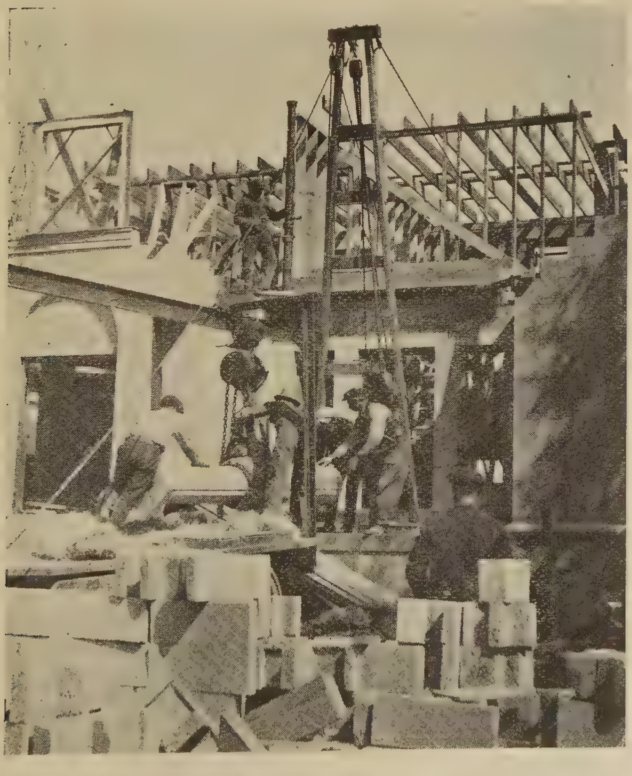


Fig. 10—Typical Construction View, Showing the Entrance Columns Being Moved into Place

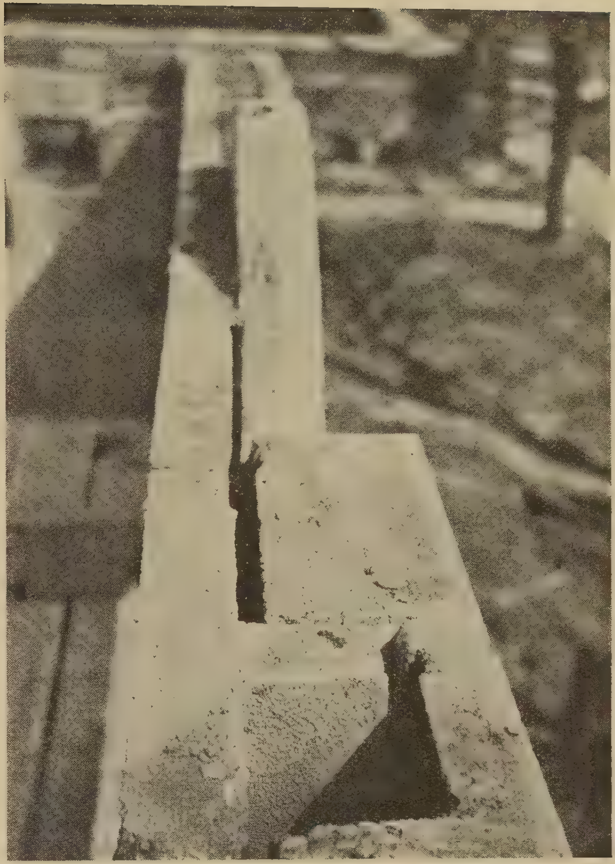


Fig. 11—View from Top of Incompleted Wall (See Fig. 9), Showing Top of Semi-Circular Window Lintel—Notice How the Air Space Between Walls Is Carefully Preserved Throughout the Construction—Double-Wall Hydro-Stone Method Is Shown in the Foreground

One of the delightful interior features is the granite finished concrete fireplace. Although of texture similar to that used on the exterior walls, it is fine enough to be pleasing in the interior, where one's standards are apt to lead to a comparison with polished marble or other fine natural stones. The sun room interior is entirely in concrete, the floor being done in terrazzo finish to match the faced block interior and cement plaster ceiling.

French windows were used in the living, dining and sun rooms, and plate glass was used all around on the first story windows. Throughout the design the consideration of labor to maintain the building was frequently taken into account, and this led to a decision for fewer and larger openings, and large window lights. For the same reasons no leaded or ornamental glass was used. On the inside the windows have but a narrow strip sill, there being no apron and stool, as is customary. Throughout the house wood trim has been used to a minimum, several of the more important openings being left entirely without casing. Red gum wood was used for all doors and trim.

The arrangement of the rooms, easily seen by the accompanying plans, is typically colonial in that it shows a center entrance, with living rooms to one side and dining room and kitchen to the other. However, the proportions of the rooms in this layout is unusually good, as to both shape and size. The lavatory is placed on a level between the first floor and the basement, convenient to both, and also where children coming in at the back door can clean up before going further into the house. Vacuum vapor heat was installed in preference to hot water, because of the quicker action and greater flexibility of the system. The building has a large attic,

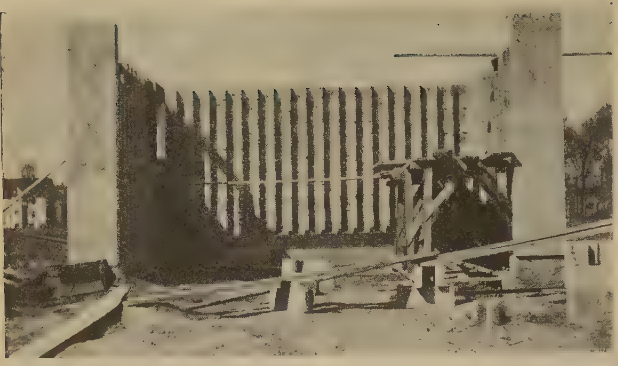


FIG. 12—THE GARAGE WALLS, OF SINGLE HYDRO-STONE CONSTRUCTION, ON WHICH FURRING, LATH, AND PLASTER ARE PLACED—THE SECOND STORY WALLS OF THE RESIDENCE ARE OF THIS CONSTRUCTION

reached by a wide stairway, and fitted out as a playroom.

The location of the garage provides a convenient and somewhat novel arrangement. The area to the front of the garage, being covered with a roof integral with the garage roof, affords an opportunity to pass under cover from the house to the garage. The garage is connected with the house by a small concrete tunnel, carrying heating, lighting and water.

Our experience with this house so far absolutely refutes the often loosely made assertions that houses with concrete walls are necessarily damp. Although there has been sufficient moisture in the air to condense considerably on the windows, under which conditions one would find walls most likely to show moisture, there has not been the slightest sign of condensation on the interior of plaster placed directly on the double block wall. Temperatures outside have recently gone down to 8 degrees above for 24-hour periods with no effect of any kind so far as the walls are considered.

I knew as well as anyone that the cost of many elements in the building of houses was still unduly high when I began building, and would decline, and I had no desire to throw away money. But I have figured right along (and my theory has proven out in practice), that the rate of deflation would likely be slower than the rate of savings, and the latter would therefore cancel the former and make it profitable to proceed with the building at that time.

This is a common theory often applied to factory construction, but not thought of so often in connection with the house. In September, 1921, I figured that I could have saved approximately 3½% in actual cost had I started construction then, but on December 15, 1921, with all the costs definitely known, and some reliable estimates on reproducing all of the various items, the possible savings have dwindled to a shade over 2%. Assuming a period of eight months' time required to erect the house, the rental item necessitated by delayed occupancy would amount to at least $250 per month for accommodations equally good, or $2,000 for the period. The operating costs for eight months, including coal, hot water, taxes, insurance and interest on investment, based on the first three months, would amount to $1,346.65, or about $168.33 per month. These operating expenses are subject to only slight variation and could not have been materially changed by awaiting lower construction costs. Subtracting the operating cost for eight months, $1,346.65, from the rental figure of $2,000 and we have a saving of $653.35, approximately $100 more than the estimated reduction in cost if construction had been started December 15. Now add to this $100 the garage rental of $12 per month for six months for the extra stall in the double garage, and the total saved by starting the building in January, 1921, is $172.

At the time we started construction we were reconciled to a money loss if necessary, looking on it as a legitimate expenditure for comfort and enjoyment lost until we got into our own home. Now we are enjoying the comforts of a concrete home, and naturally feel gratified by the fact that building early in the year—as we advise others to do—did not require financial sacrifice.

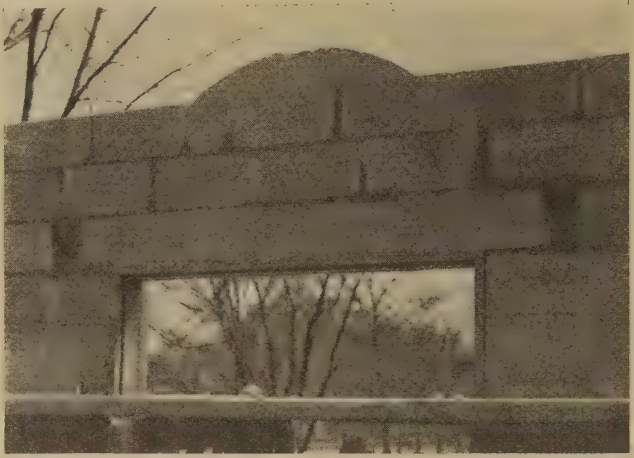


FIG. 13—INTERIOR VIEW OF FIRST STORY WALLS, SHOWING "SPLIT" LINTEL IN PLACE BEHIND A SEMI-CIRCULAR FRONT LINTEL, WHICH CAN BE SEEN IN ANOTHER VIEW (FIG. 11)—PLASTER WAS APPLIED DIRECTLY TO THESE SURFACES

The elements of cost are itemized as follows by percentage of the total:

		Per Cent. of Total Cost
1.	Land	15.75
2.	Abstract and title	.35
3.	Architect	4.15
4.	Building permits	.17
5.	Excavating	.55
6.	Hydro-Stone block and concrete art stone	16.55
7.	Mason labor and supplies	7.15
8.	Concrete (floors and walks)	5.30
9.	Carpenter labor	4.30
10.	Rough lumber	5.95
11.	Interior trim	6.15
12.	Stairs	.50
13.	Ornamental iron	.55
14.	Plumbing	4.80
15.	Plastering	2.83
16.	Stucco and carving	.58
17.	Glass and glazing	1.35
18.	Tile and terrazzo	1.55
19.	Sheet metal	.46
20.	Tile roof	...
21.	Composition roof	.40
22.	Electric wiring	2.45
23.	Hardware	1.30
24.	Heating	5.05
25.	Decorating (general)	2.70
26.	Decorating (walls)	1.35
27.	Lighting fixtures	1.45
28.	Linen shades	.44
29.	Screens	.43
30.	Gas extension	.23
31.	General contractor percentage	4.05
32.	Sundry extras	1.16
		100.00

This residence is located at the corner of Taylor avenue and Erie street, Oak Park, Ill., a suburb of Chicago, reached by frequent elevated service. When in Chicago, readers of CONCRETE are invited to look the building over.

Special attention is directed to the series of articles by Mr. Curtis (see elsewhere in this issue) on the general subject of small concrete building units in house construction.

How to Make Forms for Concrete Buildings —*Walls*

The Second Article of an Important Series Written for the Builder Who Wants to Know the Subject From the Beginning

By William F. Lockhardt
Lockhardt-Byrne Co., New York

> The literature of form work is scanty. It especially fails to meet the needs of builders who are obliged to begin at the beginning to study the subject. Contractors and superintendents have repeatedly asked Concrete to publish articles whose authors would not take it for granted that their readers already knew most of the subject. The editors cast about for the right man to prepare such articles, and were fortunate in getting the promise of William F. Lockhardt to do the job. The first article of the series, on "Footings," was presented last month; next month "Columns." Mr. Lockhardt's descriptions of form work are based on the actual practice of some of the most successful concrete building contractors in the United States. Various methods have been tried, and these methods have survived. If any reader is in doubt about some step in form building, when he has read Mr. Lockhardt's article on any one of the special subjects in the series, he will be conferring a favor on the editors and on many readers if he will ask to have the point more fully explained. A reader who has used form building methods different from the methods here described, and which he believes better for any reason whatever, will be adding something to the consideration of a very important subject if he will describe those methods for this magazine.—The Editor.

Wall forms on concrete industrial building construction are frequently not started until the structural skeleton is well under way, as they are not required for the strength of the building. In many of the smaller concrete operations, though, the concrete walls will be started as soon as the footings are poured, and for this reason they will be taken up here, although spandrel curtain walls are not built until after the pouring of the columns between which they stand.

Light cellar and foundation walls do not require anything special in the way of form design. Wall panels are made up usually of 2x4's spaced about 16 in. on center, to which the ⅞-in. sheathing is nailed. These forms are used only once, and generally wrecked as soon as stripped and the lumber used elsewhere, so that it will pay to nail them up very lightly, just enough to hold the boards in place. The 2 x 4's act as standards and run vertically, projecting above the top of the form, according to their lengths, as there is nothing gained by cutting them down. As such walls are always in an excavation, it is a simple matter to brace the 2 x 4's, which would otherwise be too light, to the bank. Often such forms are built in place, at least as far as the outside form is concerned, the standards first being erected and braced, and the sheathing then nailed on.

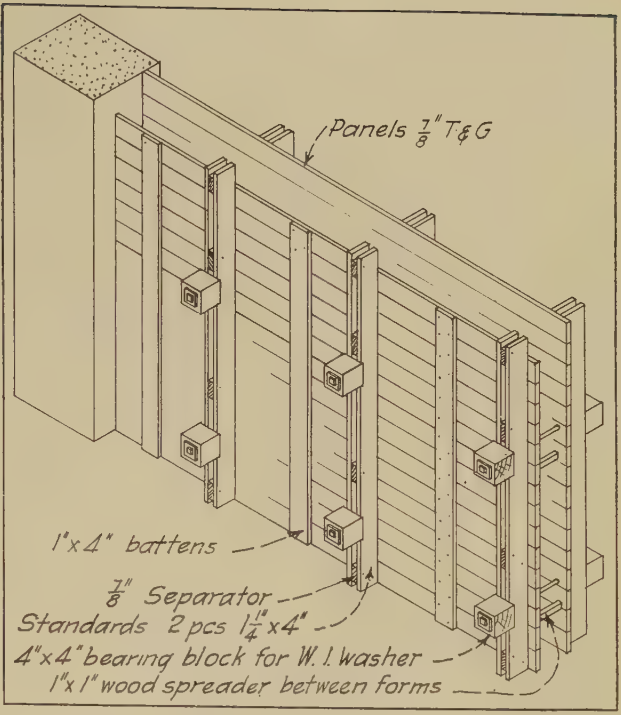

Panels 7/8" T&G
1"x4" battens
7/8" Separator
Standards 2 pcs 1 1/4"x4"
4"x4" bearing block for W. I. washer
1"x1" wood spreader between forms

Fig. 1—Wall Construction Without Waling Pieces

On industrial buildings the walls are generally of two types: (1) the full story height wall, such as shaft enclosure walls, and (2) the curtain or spandrel wall, two or three feet high, capped with a sill and carrying the sash.

Of the former, a typical example is shown in Fig. 1, in which the upper part of the column and wall have been removed. The panels for each side of the wall are made up of ⅞-in. lumber, the boards running horizontally, with 1 in. x 4 in. or 1 in. x 6 in. battens on the

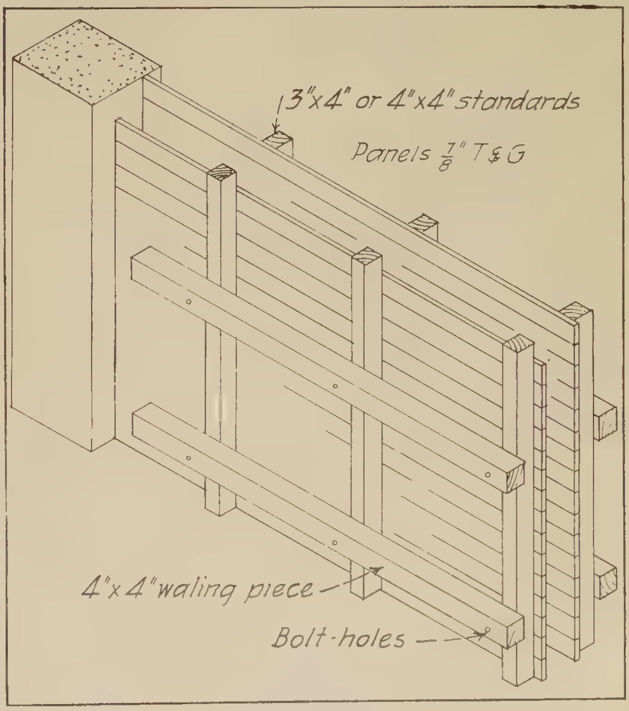


Fig. 2—Wall Construction with Waling Pieces

outside. The panels are held apart by spreaders, which may be any of the types described later. To bring the pressure on the individual boards to the bolts, the bolts are passed through standards, which in Fig. 1 are shown as being built up of two pieces of 1¼ in. x 4 in. lumber, separated by pieces of ⅞ in. lumber, to provide a slot through which to pass the bolt. In erecting these walls the customary method is to put up the panels for one side, place the steel, tack the spreaders lightly in place and then up-end the outside panel against the spreaders and brace it in place temporarily. Bolt holes are then bored through both forms at the same time by the use of a brace with an extension bit, after which the standards are placed in position and the bolts passed through and tightened up. A piece of ⅞ in. board, or a 4 in. x. 4 in. wood "washer" is often placed under the wrought iron washer, as shown, both to take up any excess length in the bolt and to give a better bearing on both parts of the standard.

It will readily be seen, however, that it may be difficult to keep a form built in this manner properly lined up, as there is nothing to counteract any tendency the wall may develop to bulge out of line as a result of the filling operation. If it is not convenient to brace each standard back to some fixed object like another wall, it will probably be better to build the wall as shown in Fig. 2.

Here the panels are braced horizontally with a 4 in. x 4 in. waling pieces bearing against all the standards. By reason of the resistance to bending offered by the 4 x 4 this wall is more easily kept in line, and the bracing back to a wall or column may be omitted. It will be noted that in this drawing the standards are shown as 3 x 4's or 4 x 4's. Either the solid standard or the built-up standard may be used, but some contractors prefer to use a little more lumber in the standards and cut out the labor of making them up. The 4 x 4's are always of use around a job, and they stand rough handling better than the lighter members. Where 4 x 4's are used it is of course unnecessary to place a bearing block under the metal washer. To save labor the bolt holes are not bored through the solid standards; they are bored through the form panel close to the standard, and through the waling piece, as shown in the drawing.

When it is necessary to leave out an opening for a window, a frame of the proper size is made up of 2 in. plank and set in place against the first panel erected before the wall is closed up. If the window is of the rolled steel type, a bevelled strip should be nailed to the outside of the box, so as to form a recess in the concrete jamb of the opening, into which the angle-iron side members of the sash can later be grouted.

It will frequently happen that in setting the forms for a basement-story wall, an opening must be left around a spur shore, which is part of the underpinning of an adjoining structure. In such a case the box frame which is set in the wall to form the opening should be made with sill and head set at an angle to make the exterior horizontal lines of the opening lower in the wall than the corresponding lines on the inside of the wall. This will to some extent check the tendency of water that may find its way down the face of the building to work into the basement through the joints around these holes, which can never be grouted absolutely tight. A recess strip should be placed around the box, to form a key for the concrete, which is placed to close the opening when the spur is removed.

As these blind walls usually finish up under a beam, they cannot be conveniently poured directly from above. Where they do not come under a beam, it is a simple matter to leave pour holes in the slab by the exercise of a little foresight at the time the floor slab above the wall location is being poured. When the wall is under a beam or girder, and pour holes cannot be provided in this way, it will be necessary to build at least three brackets per bay on the outside of the form, extending out and up far enough so that concrete may be poured into them from the floor above. These brackets usually extend out from the beam one board (5½ in.), and are about 18 in. long. It is important that the tops of all the brackets be well above the highest point to be concreted in the wall, so that a slight head or pressure may be obtained, which will ensure the wall being filled up under the beam.

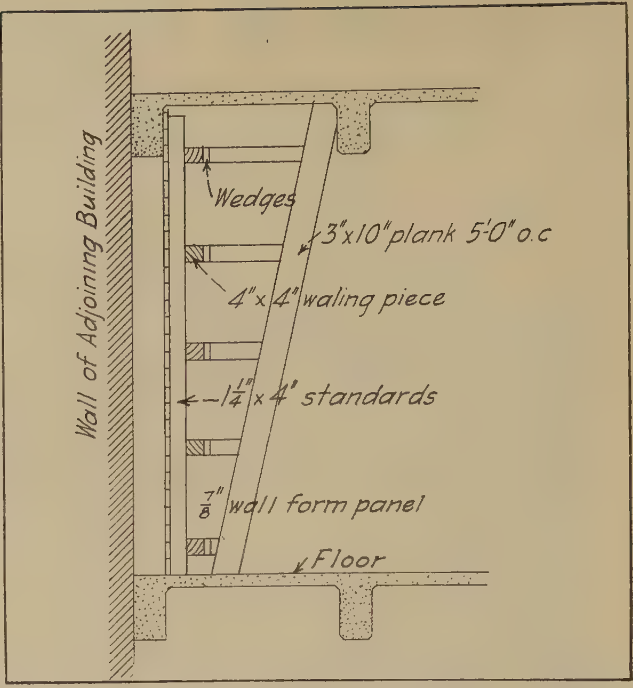


Fig. 3—Method of Bracing Wall Where Through-Bolt Cannot Be Used

It will occasionally be necessary to hold a wall form in position where a wall is being placed against the existing wall of an adjoining building. It is obviously impossible to bolt through the wall, so bracing must be used instead. Three-inch by 10-inch plank are cut slightly longer than the clear story height for that floor, with each end beveled as shown, and wedged between floor and ceiling as indicated; 4 in. x 4 in. bracing is run between the plank and the waling pieces.

In this connection it is always well to remember that liquid concrete exerts a pressure twice that of water; never pour concrete against such an adjoining wall, particularly if it is a brick wall, without looking it over carefully first, and if it is old, and laid up with lime mortar, prepare to brace it properly on the inside of the adjoining building, or pour your wall in short lifts of a few feet at a time. It is surprising how nicely an old wall or chimney can be pushed over in this way, and it is generally as expensive as surprising. Don't do it!

Low curtain walls or spandrel walls are a slightly different proposition from the story-height walls we have just been considering. The perspective sketch, Fig. 4, shows how these forms are put together. While the arrangement will vary in some details from building to building because of differences in the reveal on the column, position with reference to the beam below, etc., the general arrangement shown in the drawing can be

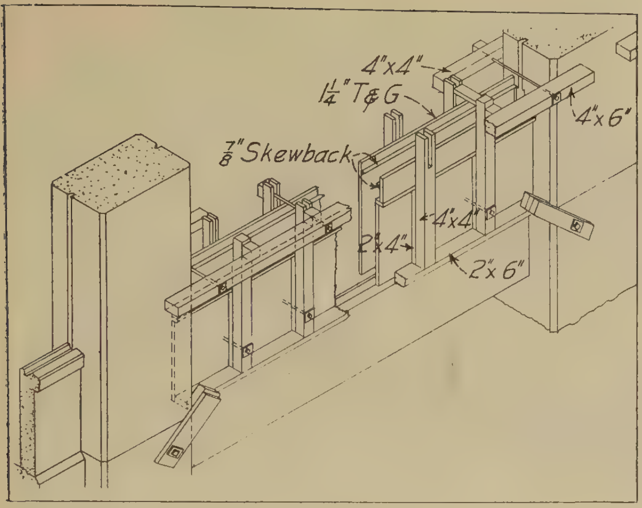


Fig. 4—Typical Form for Spandrel Curtain Wall

followed. There are usually two stud-bolts in each exterior column just below the floor level, which were used to support the exterior column form for the story above. Cleats slipped over these bolts and tightened up help hold the bottom of the wall form in place. The panel for the inside face of the wall is the same as any other wall form. The exterior panel will frequently carry a step for an overhanging monolithic sill. The overhang of this sill makes it necessary to pack out between the outside of the form and the standard, up to the underside of the sill. The top of the form is held in place by the 4 in. x 6 in. timber that spans from column to column, against which it is held in place by bolts to the 4 x 4 on the inside face of the column. One set of spreaders is placed between the form panels above the lower line of bolts; these can be knocked out easily and removed as the concreting progresses. The second set of spreaders is placed between the standards just above the sill line.

Seven-eighths-inch triangular moldings, called skew-backs, are nailed to the forms at the level of the top of the sills, to avoid sharp edges which are easily damaged. If a drip molding is required on the sill, a piece of skew-back may be very lightly tacked to the form for the overhang. This part is important, because if the skewback is nailed so tightly as to come away with the form when the wall is stripped, it will very likely bring along with it the drip molding that it was intended to form. By tacking the skewback in place very lightly it will pull away from the form and remain embedded in the concrete, and can be removed later when the outside of the building is being cleaned down, by which time the concrete will be strong enough to allow the strip to be pulled out without damage to the drip.

Spreaders have been mentioned. The most common type is obtained from a short piece of ⅞ in. board of the right length, which can be split with a hatchet to supply five or six spreaders about ⅞ in. square. If the wall is open at the top, these spreaders should be knocked out as the concrete reaches them, and removed. When the wall is closed at the top, as when it reaches to the ceiling, the spreaders will of course have to be left in. Sometimes by tapering them and greasing them with a very heavy grease, they can be driven out while the concrete is still green, but this does not always work. If the spreaders are left in the wall, they should be cut back with a chisel at least an inch before the cement mason points up over them.

With the aid of a piece of pipe and a bolt, spreaders have been made of concrete that look like large size concrete macaroni. They have the advantage that by placing the bolt through the hole in the center of the spreader it becomes unnecessary to pull the bolts out of a wall the day after the wall is poured. This is an advantage in hot weather, if it should be desirable to pour a wall on, say, Saturday, or just before a holiday.

Another type of concrete spreader is shown in Fig. 5. These spreaders are made up in gang molds, with a 10-penny nail cast in each end to hold them in place against the forms. To avoid having rust marks show on the face of the building, the masons, when cleaning down, must be sure to knock the whole nail out of the spread before pointing over it.

There are a number of metal wall ties and separators on the market, but many of them either have to be ordered of the exact length to fit a wall of a given thickness, thus lacking the flexibility of bolts, or they leave some metal close to the face of the wall, where it will rust sooner or later and disfigure the building. Their claims for economy each man will have to judge for himself; many large contractors use them, and others equally large do not. Their usefulness depends in part on the individual way of working, and no fixed rule can be applied.

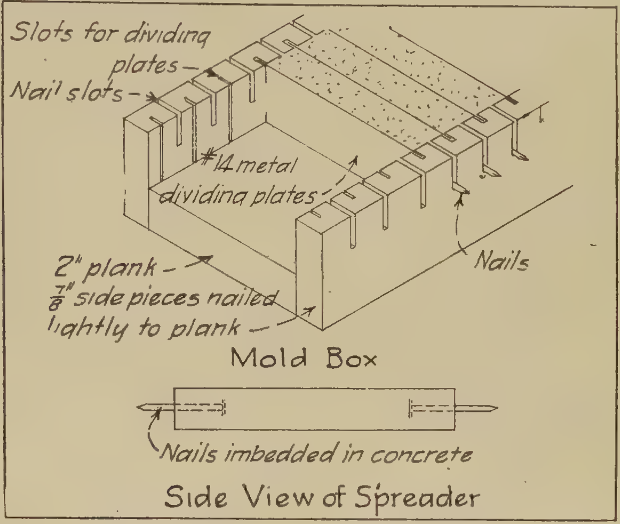

Slots for dividing plates
Nail slots
#14 metal dividing plates
2" plank
⅞" side pieces nailed lightly to plank
Nails
Mold Box
Nails imbedded in concrete
Side View of Spreader

Fig. 5—A Concrete Form Spreader and the Mold in Which It Was Made

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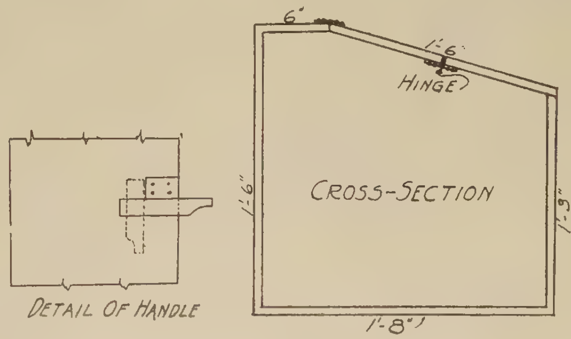
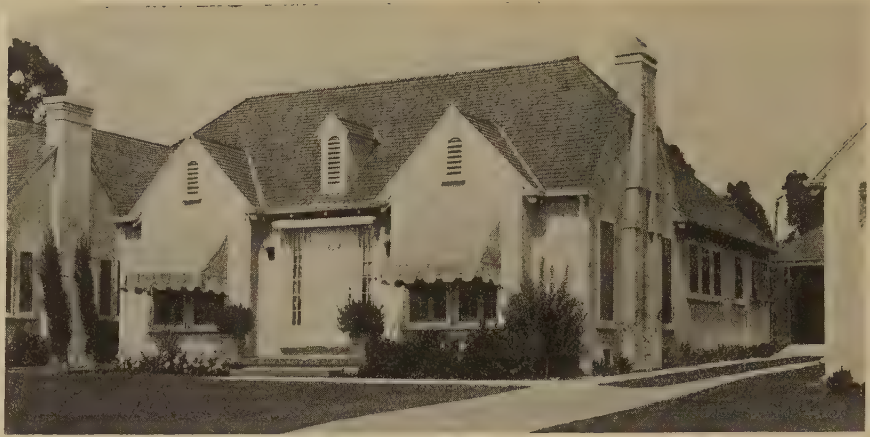


A Tool Box

Here is a tool box for a gang of 6 men. It is 4 ft. 6 in. long, has a folding lid which is laid flat when the box is open and therefore does not get broken off or upset the box. The handles also fold out of the way when not in use for lifting the box which saves many a bump on the shin.—A. C. Fish, Ottawa, Kansas.

A New Style Bungalow in California

By Charles Alma Byers

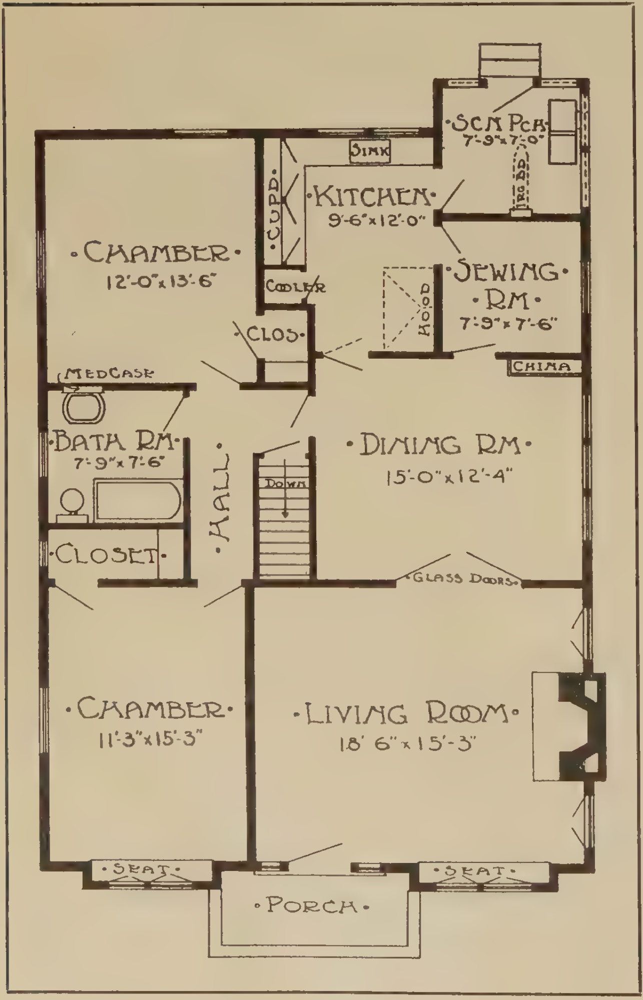


The exterior walls of this bungalow are of very light gray cement-stucco over frame construction, and the wood trimming is in white. The particularly attractively designed roof is of shingles, painted grayish green, and the concrete-paved entrance porch is edged with red brick. The windows of the front wall, as well as the pair at each side of the chimney, are of the narrow casement type.

The built-in features of this plan include a window seat in each the living room and the front bedroom, a china cupboard in the dining room, and draught cooler-closet and the other customary conveniences in the kitchen.

The interior woodwork throughout is of pine, which in the living room and dining room is finished in light French gray, in the bedrooms, hall and sewing room is in white paint. All walls are plastered, and those of the bath room and kitchen are finished in wainscote effect with a smooth, hard plaster coat enameled like the woodwork, while in the other rooms they are papered. Oak floors prevail throughout, except in the bath room, kitchen, sewing room and rear-entry porch. Tile flooring is used in the bath room, and pine covered with linoleum is used for these other divisions. The fireplace of the living room has a tile hearth and a Colonial-style mantel.

The house has a small concrete basement, and the equipment includes a good furnace and all other modern conveniences. It is located in Los Angeles, California, and was designed by Preston S. Wright, of that city.



Government to Make Tests of Corrosion of Buried Pipe

The Bureau of Standards has undertaken an extensive investigation of the corrosive action of soil on pipes used for gas and water mains and service pipes. Forty locations have been selected as representative of the principal families of soils to be found in the United States, and at each will be buried a number of samples of every kind of iron and steel pipe in commercial use. A few pieces of pipe coated with representative pipe coatings, designed to prevent soil corrosion, and a few pieces of lead sheath cable, both plain and armored, will also be buried. Some of the samples will be uncovered from time to time for examination to determine the rate of corrosion. The field tests will be supplemented by laboratory tests, giving complete data on the physical and chemical properties of the soil.

The results of the tests should be of value in determining the causes and importance of soil corrosion, and in selecting the kind of pipe best suited for use in any particular soil. The experiment will continue over eight or ten years, but it is expected that a large amount of data as to the relative rates of corrosion of various kinds of pipes will be obtained within two or three years.

The Semi-Annual Index to CONCRETE, Vol. 19, July to December, 1921, is available for those subscribers who ask for it.

Concrete for Mines and Mine Buildings

Some Applications for Concrete in Northern Michigan Iron Mines —Continued from February CONCRETE

By B. G. Best
Ironwood, Mich.

Concrete Boiler House, Tilden Mine

Figs. 6, 7, 8, 9, 10 and 11 are plans, sections and exterior views of a concrete boiler house, built by the Oliver Iron Mining Co. at the Tilden mine, Bessemer, Mich. The building is 56 ft. 8 in. by 34 ft. 6 in. in size, and has poured concrete walls, floors and roof. The foundation walls are 24 in. thick up to the floor level, and 20 in. thick to the bottom of the building wall, which is 1 ft. 7 in. above the floor level. The building walls are 12 in. thick in the main part of the building and 18 in. thick around the coal bin and locker room below the coal bin deck. The distance from the floor line to the top of the coping is 32 ft. 9½ in., making the maximum height of wall 31 ft. 2½ in. The roof slab is 2½ in. thick, with 1½ in. ribbed reinforcement, and having a slope of ½ in. to the foot. The roof is supported by steel trusses and I-beams, which are in turn supported by steel columns. The purlins are 8 in. I-beams. The main floor of the building is of concrete and 6 in. thick. The floor of the coal bin is of similar construction and slopes at an angle of 30°. The coal bin deck is a 4 in. concrete slab, reinforced with No. 39A triangular mesh, and is supported by steel I-beams and columns. Ample reinforcing is placed around all window and door openings, and all outside walls are reinforced with ¼ in. diameter rods spaced on 24 in. centers, both vertically and horizontally, and 2 in. from the outside face of the wall. This plant is also equipped with a concrete housing for the water softener and a reinforced concrete chimney 66 in. by 125 ft. Steam lines to the shaft and engine house are laid in a reinforced concrete trench.

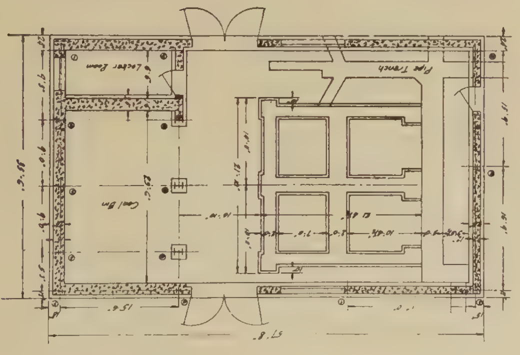


Fig. 6—Foundation and Floor Plan, Concrete Boiler House, Tilden Mine

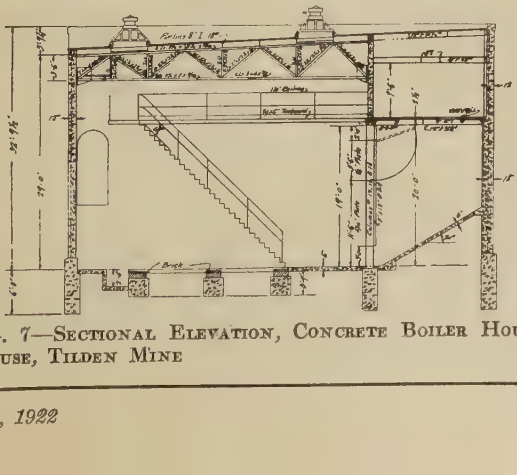


Fig. 7—Sectional Elevation, Concrete Boiler House, House, Tilden Mine

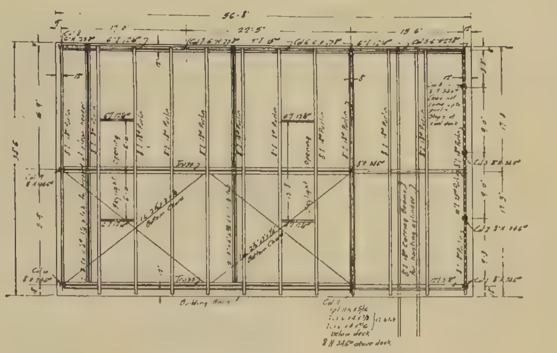


Fig. 8—Roof Plan, Concrete Boiler House, Tilden Mine

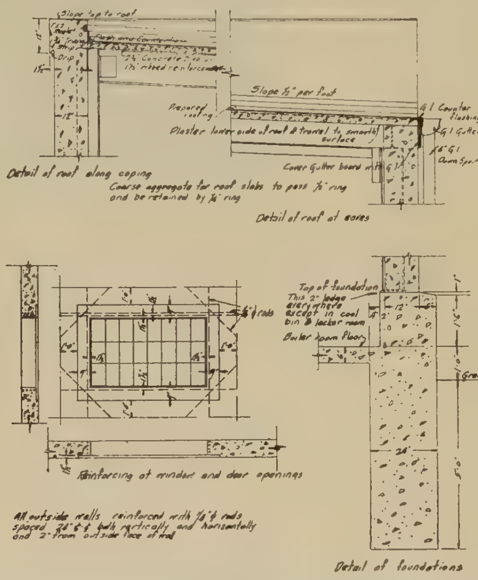


Fig. 9—Details, Concrete Boiler House, Tilden Mine

Sub-Station, East Norrie Mine

One of the first concrete mine buildings to be erected on the Gogebic Range was the sub-station at "D" shaft, East Norrie mine, Ironwood, Mich. This building is 17 ft. by 26 ft. and built entirely of concrete. The foundation walls are 12 in. thick and extend 5 ft. below grade, sufficiently deep to prevent damage from frost. The building walls are also 12 in. thick, reinforced at all openings with ¾ in. and 1 in. rods, and with ¼ in. rods spaced on 24 in. centers running vertically and horizontally 2 in. from the outside face of the wall. The top of the coping is 15 ft. 8 in. above grade. The concrete floor is 4 in. thick and laid on a 3 in. cinder fill. The roof is a concrete slab 6 in. thick, reinforced with No. 38 triangular mesh, which extends well into the building walls. Midway between the end walls the roof is supported by a 14 in. by 18 in. concrete beam, reinforced with four ¾ in. diameter rods. The roof slab is covered with a 1 in. layer of flaxlinum, mopped on with asphalt, over which is laid prepared roofing. A 1:2:4 mixture was used throughout the building, except for the window sills, which were precast. Fig. 12 shows the wall and roof section and Fig. 13 is an exterior view.

All of the buildings described this far were built al-

Fig. 10—(Upper Left, Front View) Boiler House, No. 10 Shaft, Tilden Mine

Fig. 11 — (Right, Rear View) Boiler House, No. 10 Shaft, Tilden Mine

Fig. 13 — (Lower Left) Sub-Station, "D" Shaft, E. Norrie Mine

most entirely by crews regularly employed at the mines. The only outside men employed were those added to the regular crews in rush seasons, and none were employed to do work which could not be done by the regular force.

Miscellaneous Applications—Surface, Concrete Chimney, Pabst Mine

Some years ago the Oliver Iron Mining Co. decided to electrify its properties on the Gogebic Range, and to replace, as far as was practical, all steam driven machinery with electrical equipment. In accordance with this plan it was decided to enlarge the hoisting plant at "G" shaft, Pabst mine, and convert it into a central power station. One of the first steps was the addition of several boilers and the erection of a reinforced concrete chimney. The chimney is 202 ft. 6 in. high, with inside diameters at the top and base of 9 ft. and 12 ft. 6½ in., respectively. The corresponding outside diameters are 9 ft. 10 in. and 14 ft. 10¾ in. An inner shell of fire brick, having an inside diameter of 9 ft., extends 70 ft. above the top of the footing. The footing is 27 ft. square and 5 ft. deep, and is reinforced with two rows of bars. The lower row consists of 27 1-in. bars in each direction, spaced 7 in. center to center. There are 12 ¾-in. bars in each direction in the upper row, spaced 24 in. center to center. The vertical reinforcing in the chimney consists of ¾ in. bars on 6 in. centers, and the horizontal reinforcement is American Steel and Wire style 23 mesh. The chimney was built by the General Concrete Construction Co. of Chicago and New York.

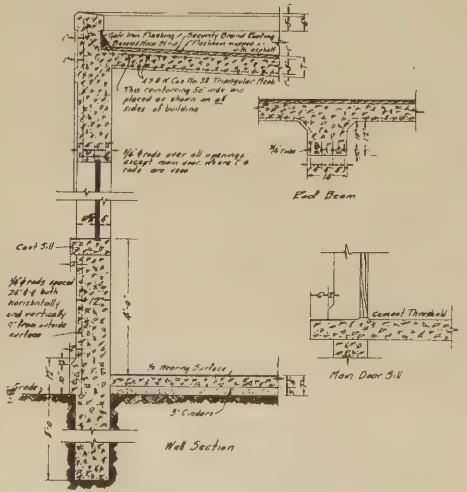

Galv. Iron Flashing & Beveled Nose Strip
Security Brand Coating Flashings mopped on with asphalt
A S & W Co. No. 38 Triangular Mesh
This reinforcing 50" wide and placed as shown on all sides of building
¼" ϕ rods over all openings except main door, where 1" ϕ rods are used
End Beam
¾" rods
16"
Cont. Sill
¼" ϕ rods spaced 24" c-c both horizontally and vertically 2" from outside surface
12"
4'-0"
½ Wearing Surface
Grade
5'-0"
3" Cinders
Wall Section
Cement Threshold
Main Door Sill

Fig. 12—Details, Sub-Station, "D" Shaft, E. Norrie Mine

Ash Handling Equipment, Pabst Mine

Beneath the floor of the boiler house is a concrete lined tunnel leading to a shaft and sump similarly lined. Ashes are drawn from the boilers into a tunnel car, trammed to the shaft, dumped into a skip and hoisted electrically to the top of a cylindrical ash hopper, where they are dumped, later to be carried away in railroad cars or by truck.

Cooling Pond, Pabst Mine

In 1917 a concrete cooling pond was built near the boiler house. The pond was 76 ft. by 168 ft. outside, with a minimum depth (top of wall to top of floor slab) of 6 ft. and a maximum depth of 7 ft. Near the center of the side of the pond nearest the boiler house is a sump 12 ft. deep. The walls of the pond are 6 in. thick at the top and the sump walls 8 in. thick. The outside faces of all walls are vertical and the inner faces battered. The walls are reinforced with two layers of No. 267 triangular mesh placed 1¼ in. from the inner and outer faces. The floor for a distance of 4 ft. 6 in. from the outside of the walls is 8 in. thick, and was poured at the same time as the wall. The wall reinforcement extends past the inner edge of this part of the floor slab and is imbedded in the central part of the floor. Concrete was poured continuously in building the walls and outer portion of the floor, day and night shifts being worked. The central portion of the floor is a 6-in. concrete slab reinforced with No. 126 triangular mesh. An expansion joint, ⅝ in. by 4½ in., filled with asphalt oakum, extends around the pond at the junction of the 6-in. and 8-in. floor slabs, or 4 ft. 6 in. from the outside of the walls. Two similar cross joints divide the central part of the floor into three slabs. Twenty-two columns, 12 in. square, each reinforced with four ½-in. rods, support the piping. In 1920, when a larger pond was required, a 50 ft. addition was made to one side of the pond. Except for size, the addition is similar in

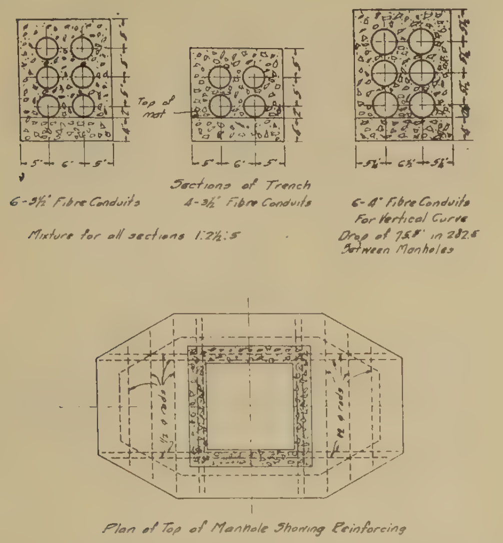


FIG. 14—ELECTRIC TRANSMISSION SYSTEM, NORRIE MINE

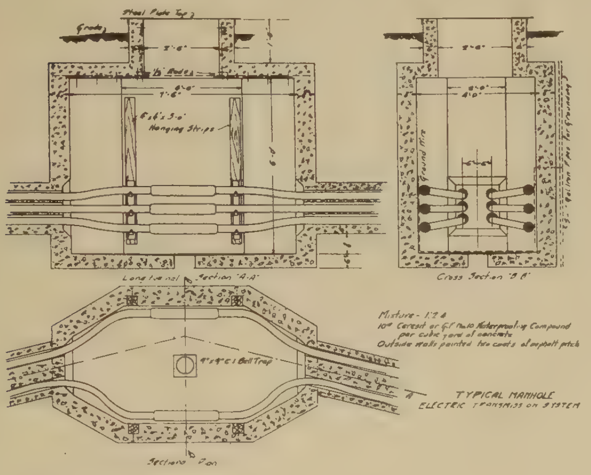

Steel Plate Top
Grade
2'-6"
7'-6"
6'-0"
4'-0"
Hanging Strips
Ground Wire
Longitudinal Section "A-A"
Cross Section "B-B"
Mixture - 1:2:4
10# Ceresit or 6# Medo Waterproofing Compound per cubic yard of concrete
Outside walls painted two coats of asphalt pitch
C.I. Bell Trap
TYPICAL MANHOLE
ELECTRIC TRANSMISSION SYSTEM
Sectional Plan

FIG. 15—TYPICAL MANHOLE, ELECTRICAL TRANSMISSION SYSTEM, NORRIE MINE

design and construction to the original pond. Where the new concrete was to be bonded the surfaces of the old concrete were roughened and cleaned, and short rods grouted in holes drilled in the old concrete. About half of each rod was allowed to project from the surface of the old wall, to be embedded in the new concrete. No trouble has been experienced through leakage at the joints of the two walls. When the addition was complete, the water was drawn from the original pond and holes cut in the dividing wall. This was done on a day when the mine was not working, and no delay was caused. The mixture used in both the old and new ponds was 1:2:4.

ELECTRIC TRANSMISSION LINE—IRONWOOD MINES

Connecting the central power plant at the Pabst with the different engine houses is an electric transmission line laid in a concrete trench. This conduit line is 7,342 ft. long, with a maximum difference in elevation of 93½ ft. The minimum grade in the line is 0.44%, the maximum 42%, and the average grade 4.3%. In the entire line there are eight vertical curves. There are 14 regular and two special manholes in the line. The shortest distance between manholes, or between a manhole and a building, is 92 ft. The longest distance is 483 ft., and the average distance 335 ft. In all but one section of the trench 3½ in. fibre conduits were used, where between two manholes 282½ ft. apart, the difference in elevation is 75½ ft. In this section 4 in. conduit was used. Details of the trench and manholes are shown in Figs. 14 and 15. The average depth from surface to the top of the mat was about 4 ft., the minimum depth 18 in., and the maximum depth between 10 ft. and 12 ft. Grade and line stakes were placed at 50 ft. intervals, except on vertical curves, where they were placed 25 ft. apart. At all manholes cross center lines were given to assist in placing the template used in excavation, and later in placing the forms. The width of the excavation was kept as close to 16 in. as was possible, so that the form work was reduced to a minimum. A few boards were used where the width of the trench was much greater than the width of the concrete, or where necessary to prevent earth from falling while the concrete was being poured. The excavating was done by two gangs. The first dug the trench to the approximate depth of the top of the mat, and the second, or trimming gang, completed the excavation and left the trench in readiness for the concrete. Before starting to pour concrete in a section of the trench a template for the conduit was placed in the manhole or building wall. The 4 in. concrete mat was then poured for a short distance and a standard length of conduit placed in position, using the template and wooden spacing blocks set on the concrete. Concrete was poured to the top of the conduit and the second layer of conduit placed, using spacing blocks set on the top of the first layer. Concrete was poured to the top of the conduit as before, the third layer placed, and the concreting completed. The conduit in the second layer were about a foot shorter than those in the first, and those in the top layer about 2 ft. shorter. In this way the end of each layer of conduit was kept about a foot in advance of the next higher layer, and the work of tarring and taping the joints was made much easier than if they had been in the same vertical plane. After the first section had been placed conduit of standard length were used until the next manhole was reached. While the first three layers of conduit were being placed and the concrete poured, the next conduit in the lower layer were put in position and the joints tarred and taped. From this point the work proceeded as before. Sand and stone were stored along the line of the trench, and as the work progressed the mixer was moved ahead, so that at no time was it necessary to wheel concrete for any great distance. A 1:2½:5 mixture was used in the trench, and a 1:2:4 mixture in the manholes.

After a section of trench had been completed 5 ft. sewer rods were pushed through each of the conduits from manhole to manhole. Attached to the last rod was a ¾-in. or 1-in. manila rope. When the rope was pulled through the conduit two ⅜-in. galvanized wires, twisted together, were pulled through. A steel cylinder, 3 in. in diameter and 8 in. long, was fastened to the wires and pulled through to remove any dirt that may have lodged in the conduits and to smooth off any irregularities. Attached to the rear end of the cylinder was a wire rope, which served two purposes. If the cylinder encountered any obstruction and could not be pulled to the next manhole, the rope was used to pull it back. If the cylinder was drawn through without difficulty, the rope was fastened to the electric cable and pulled through the conduit. Eighteen thousand five hundred ninety-seven feet of cable was required, all of which was 350,000 circular mils in size, three conductor, 5,000 volt, rubber insulated and lead covered, and 900 ft. was in addition juted and armored. Any water which may enter the trench is taken care of at the engine houses or by drains placed in two of the manholes.

Figs. 16 and 17—Effects of Excess of Water and Insufficient Tamping

Septic Tanks

The disposal of sewage, which of late has become an important factor in mining operations, is readily accomplished by the use of concrete septic tanks. As used at mines such tanks vary in size from small tanks to dispose of the sewage from a single building to the larger type having sufficient capacity to treat all the sewage from the buildings in the vicinity of the mine.

Reservoirs and Tanks

In building a water tank or reservoir of concrete, the first consideration is the selection of a site where the tank will not be damaged by the settlement of ground due to mining operations. This seemingly simple precaution has been overlooked or forgotten more than once, and the cracks which later developed were blamed on poor materials or workmanship. Waterproof tanks of concrete require the best of materials and workmanship. To secure the best results, dense, well graded aggregates should be used, and the concrete proportioned so as to give a mixture of maximum density. This usually means a rich mixture. No more water should be used than is necessary to make the concrete of such consistency that it will readily flow around the reinforcement. The concrete should be well mixed, tamped and spaded. Whenever possible the entire structure should be poured at one time. If continuous pouring is impossible or impracticable, vertical sheets of metal should be placed in the last concrete poured, to serve as a bond to the new concrete, and before the second pouring is commenced the old concrete should be thoroughly cleaned and all scum and laitance removed. Figs. 16 and 17 show the result of an excess of water and insufficient tamping and spading.

Cleaning Cement Sacks

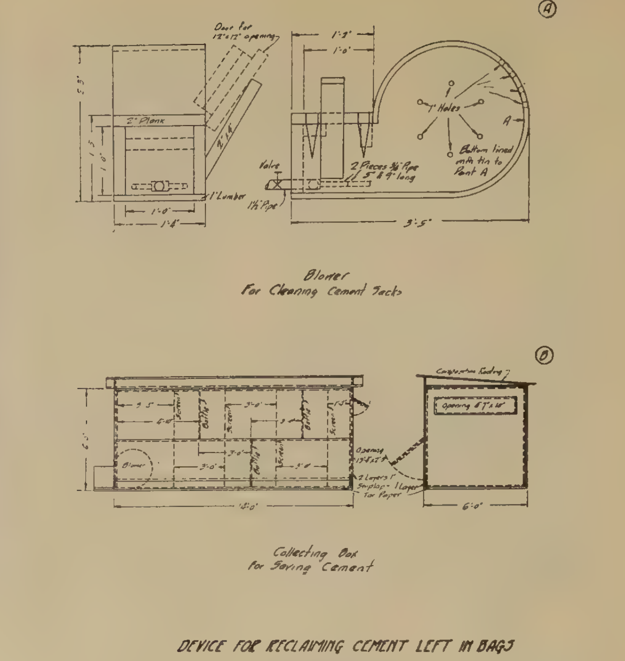


Fig. 18—Device for Reclaiming Cement Left in Bags

A few years ago, when the Oliver Iron Mining Co. was erecting the concrete buildings previously described, at Ironwood, the cement sacks were cleaned in a blower, the details of which are shown in Fig. 18A. Compressed air under a pressure of 50 to 100 lbs. is used. The valve in the 1½-in. air line is opened slightly and about 20 sacks, three or four at a time, are thrown into the blower. The door is closed and the valve opened wide. The sacks are whirled around in the cylindrical part of the blower and the cement escapes through the 1-in. holes bored in the sides and end. The blower in operation is shown in Fig. 19. Under an air pressure of 100 lbs., 20 sacks can be placed in the blower, cleaned and removed in three minutes. In eight hours two men have cleaned and tied in bundles 3,000 bags. Recently, in an attempt to reclaim at least part of the cement left in the bags, the collecting box shown in Fig. 18B was added to the blower. The box is 6 ft. by 6 ft. by 14 ft. in size, and made of two layers of 1-in. shiplap with a layer of tar paper between. A hole is cut in the end to fit the square part of the blower, the cylindrical part being placed inside the collecting box. Four screens of wire cloth are placed across the box as shown, between which are three baffle boards one-half the height of the box. In the end of the box farthest from the blower is a screened opening through which the air escapes. In one side of the box is a door for the removal of the cement recovered. The top of the box is sloped and covered with prepared roofing. When the box was built wire cloth was not available, and three thicknesses of ordinary window screen were used in place of one thickness of cloth. Even with this crude arrangement, one man in twelve hours cleaned 3,300 sacks and reclaimed about 1,000 lbs. of cement, or one-third of a pound of cement per sack cleaned.

Fig. 19—Cleaning Cement Sacks by Compressed Air

Small Units in House Building

Support of the Floors, Sills and Lintels—Part 3

By A. J. R. Curtis
Chicago

Because of its many exclusive advantages, the concrete floor is unhesitatingly recommended for all good houses having monolithic walls or masonry walls of any kind.

Concrete floors are particularly adaptable to the concrete block house, and while the general methods of constructing concrete floors will not be dealt with in this article, some practical methods of support on block walls will be briefly explained.

The concrete floor should rest on the inner half of the block bearing walls. It should never extend to the outer surface of the block, for several important reasons. It is always desirable in residence construction to cover the joor slab from exterior view, and this is done in most cases either by laying a course of veneer block (Fig. 34), or, in case the wall is to receive stucco, sometimes by extending the floor slab out flush with the outer line of the block. In such case the stucco is applied to the sides of the floor slab, giving the walls and slab a monolithic appearance. This is decidedly poor practice, since the floor slab is very likely to expand and contract sufficiently to cause cracks in the stucco. A slab so placed cuts off the air spaces and makes no provision for the escape of water which might, in some way or other, get into these spaces. The approved method of placing the floor is illustrated in Figs. 30 and 31.

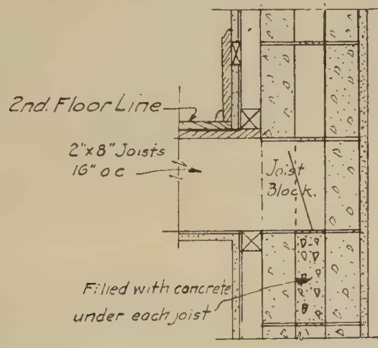


Fig. 25—Standard Method of Supporting Wooden Floor Construction on Concrete Block Walls, Where the Combined Floor Loads Exceed 60 lbs. per sq. ft.

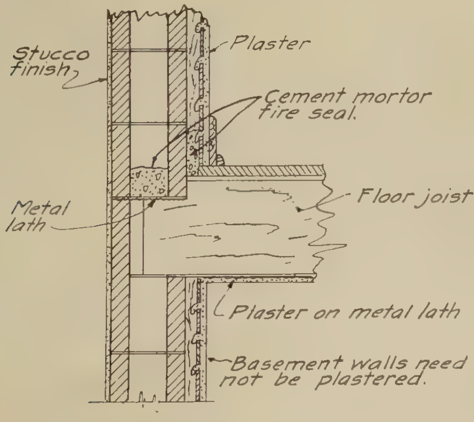


Fig. 26—Typical Wooden Floor Support on Concrete Block Walls, Where the Combined Floor Loads Do Not Exceed 60 Pounds per sq. ft.

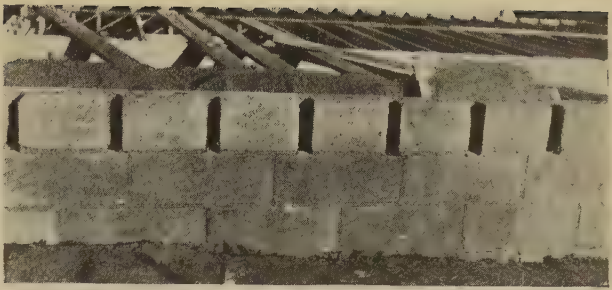


Fig. 27—View of the Joist Block in Place, Showing Recesses Left for Wooden Floor Joists

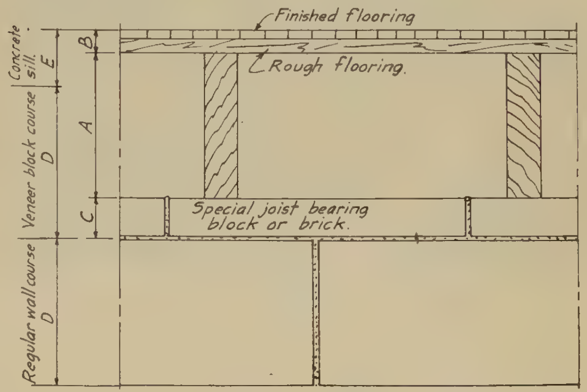


Fig. 28—Diagram Indicating Method of Bringing Wood Floor Construction to Any Desired Level on Block Walls—The Joists Rest on a Special Joist Bearing Course of Block or Brick

End forms for the floor are generally placed as shown in Fig. 32, being held in position or braced by means of vertical members placed in the air spaces. Fig. 33 shows an interior view of a wall ready for the floor forms, and Fig. 34 shows the approved method of leaving air space around the floor slab. If the concrete floor slab is supported on a system of beams, the latter will usually rest on solid block construction. The solid block are usually required only in the course immediately supporting the beams, but sometimes two or three courses are laid under particularly heavy loads. The current standard specifications of the American Concrete Institute for concrete block require that where girders or joists rest on concrete block in such a manner as to cause a concentrated load of over 4,000 lbs., the block supporting the girders or joists must be made solid for

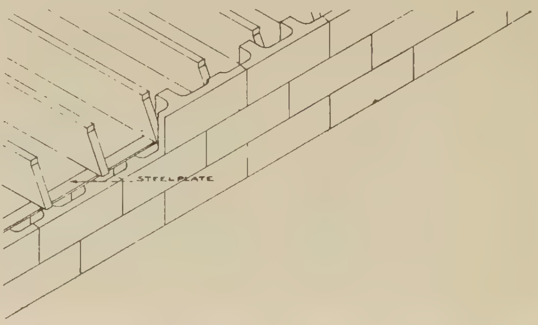
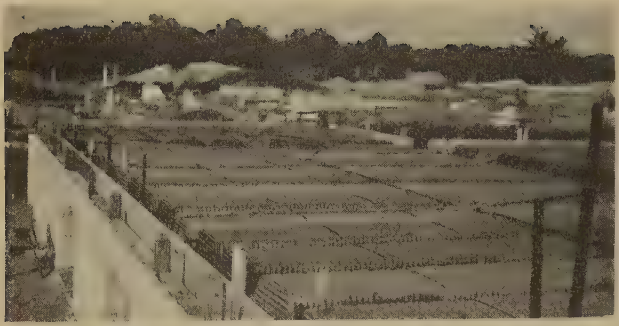


Fig. 29—Method of Supporting Wooden Floors on Walls of Single Wall Hydro-Stone and Similar Construction—⅜-in. Steel Plates 6 in. Wide Are Supported on Block Lugs, Which Are 12 in. Apart, Center to Center



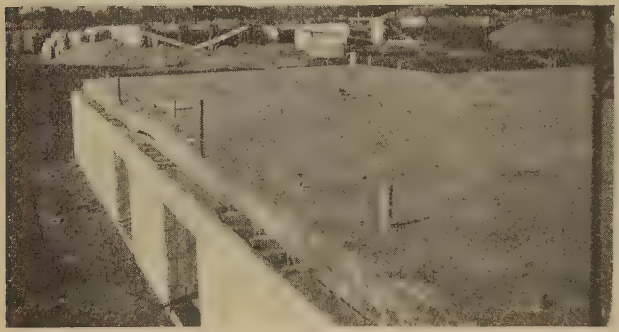


Fig. 30—Forms in Position for Placing Concrete Floor, Supported on Concrete Block Walls

Fig. 31—After Placing Floor, as Shown in Fig. 30—Notice Floor Supported on the Inner Half of the Wall—The Split Concrete Lintels Recommended in Residence Construction Can Be Seen

at least 8 in. from the inside face of the wall, except where a bearing plate is employed to distribute the load so that it will not average more than 300 lbs. per square inch of gross cross sectional area on solid block, or 167 lbs. on hollow or two-piece block.

Wood Floors

For some time to come many dwellings will be built with wood floors. Wood has constituted the prevailing type for so long that the change to concrete floors naturally will not be immediate, although in view of the unquestioned superiority of concrete and the diminishing supply of forest products, the change is bound to come. In ordinary residence construction the floor loads are so light that the joists are easily carried directly on the inner side of the block, as shown in Fig. 26. Where the combined floor loads exceed 60 lbs. per sq. ft., these joists are supported on solid block, as shown in Fig. 25. The true shape and uniform dimensions of the block make it easy to obtain a plumb and generally satisfactory seating of the joists very easily. "Joist courses" in block walls usually consist of veneer block on the outside (the thickness of which is a trifle less than half the regular block thickness), and "joist block" laid on the inner surface of the wall between block. Joist block are in most cases plain slabs of such length that they

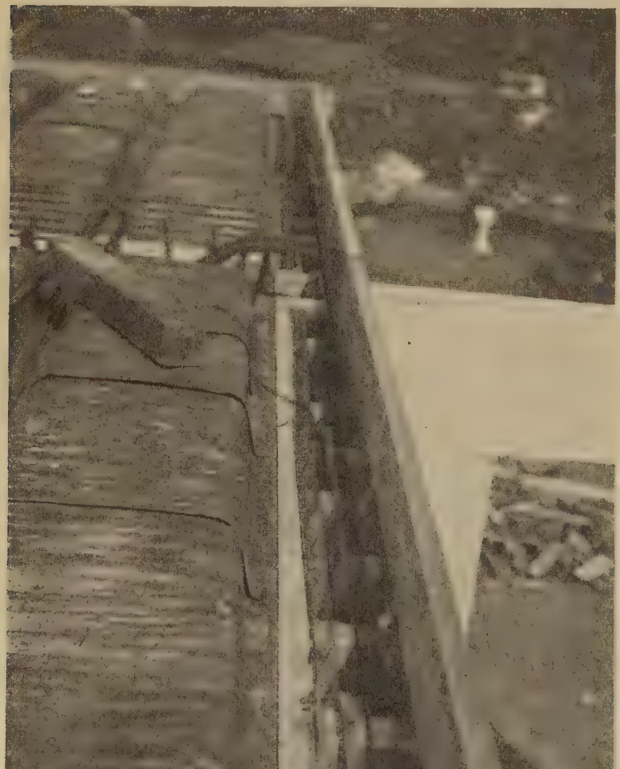


Fig. 32—Forms in Position for Placing Floor Slab on Concrete Block Wall—Freshly Deposited Concrete Is Prevented from Running Down the Air Spaces by Means of Metal Fabric or Metal Placed as Shown

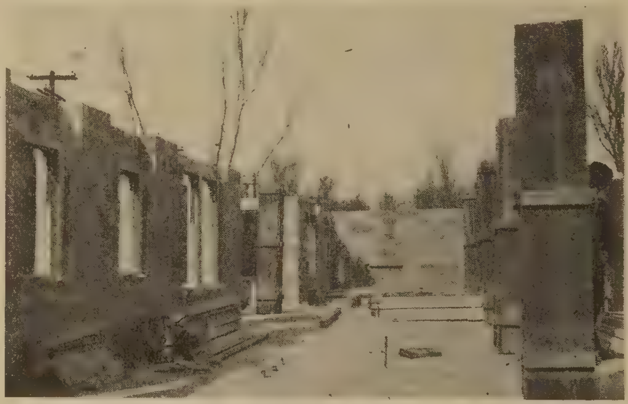


Fig. 33—Interior View of Concrete Block Walls, Showing Recesses Above Windows, Which Are to Receive the Lintels and Floor Beams, All Cast Integral with the Monolithic Floors

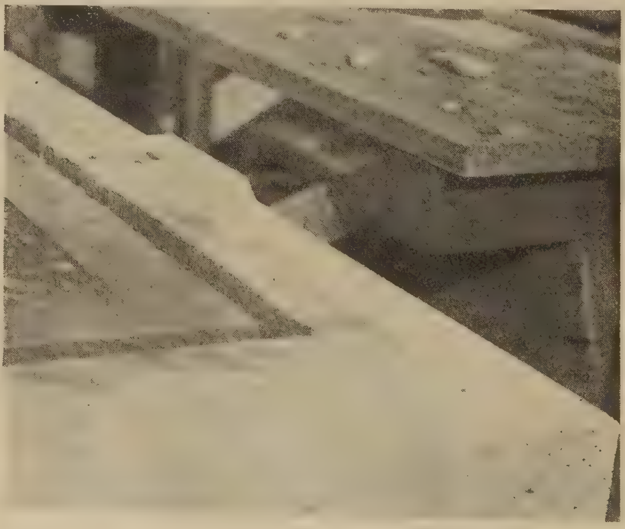
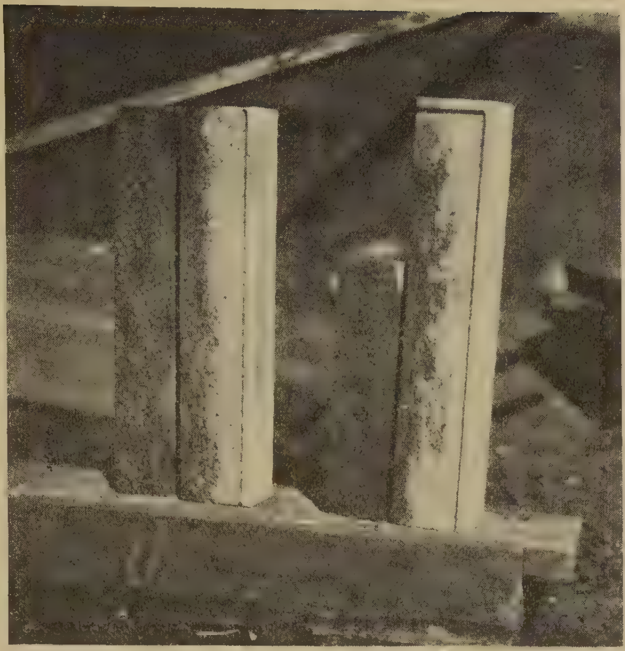


Fig. 34—A Corner of the Floor Shown in Fig. 32, Showing How the Slab Is Built Up on the Outer Edge to Make It Equal in Depth to the Water Table Veneer Block on the Outside—The Inner Side of the Next Course of Block Will Be Supported on the Floor, the Outer Side on the Water Table



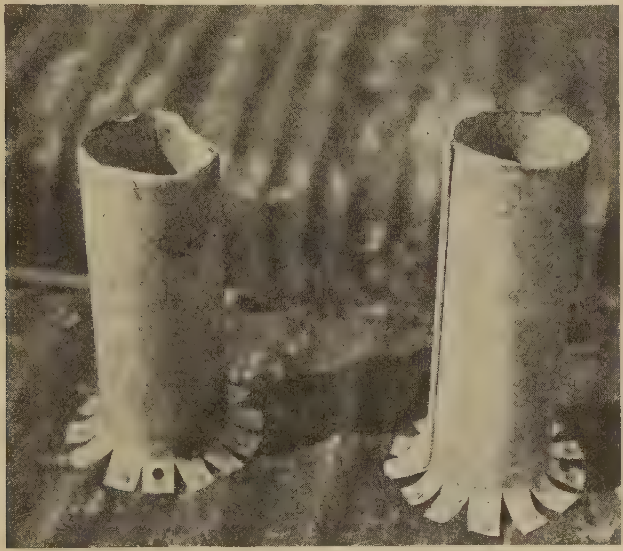


Fig. 35—Water Table and Belt Courses Are Best Made in Two Pieces as Shown—Two-Piece "Specials" Help to Reduce the Heat Conductivity of the Walls and Absolutely Prevent the Direct Passage of Water

Fig. 36—Galvanized Sleeves Set in the Floor Forms Produce All Necessary Openings for Pipes—Cutting Through Concrete Floors Is a Luxury too Expensive to Be Attractive

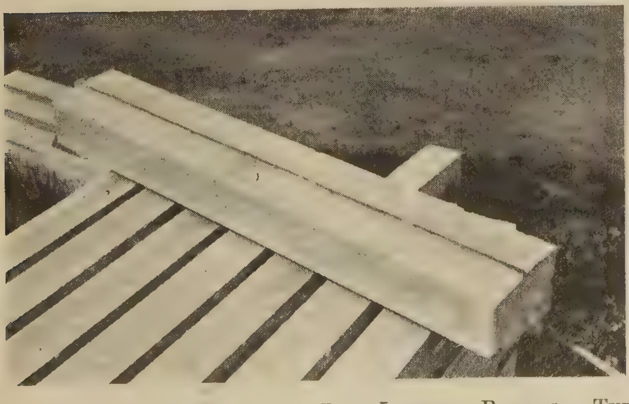


Fig. 37—Concrete Sill with Zinc Liner, a Practical Type for Other Set-in and Slip-Sill Construction

exactly fill the space between joists. Fig. 27 shows the joist and veneer block in position.

Wooden floors are supported on walls of single or "lug block" like the single wall Hydro-Stone, and the Synstone types, by means shown in Fig. 29. The diagram shown in Fig. 28 illustrates the usual method of supporting wood floors at levels not corresponding to an exact number of courses.

Sills and Lintels

In general all sills and lintels which are set in the wall as it is laid should be of such size as to exactly replace a given number of whole or half block. Even though the sills proper in some cases cannot be made in accordance with this suggestion, the sill can be cast as a part of a larger unit exactly replacing whole block.

Residence construction of the very highest type calls for the use of split sills and lintels, that is, sills and lintels having a vertical division running parallel to the long dimension of the units. A sill or a lintel made in two parts may be laid in the wall with the individual sections only half an inch to an inch apart, for this distance is sufficient to make the passage of water impossible and to protect against the dissipation of heat, an occasional fault with one-piece sills. The sill shown in Fig. 39 and the lintels in Figs. 31 and 40 are of the two-piece type.

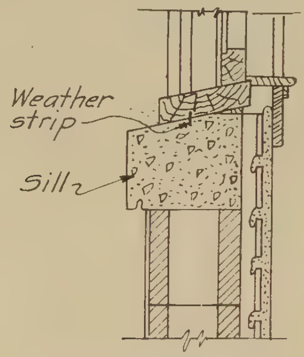


Fig. 38—Zinc Liners or Water Stops Should Extend ½ in. to ¾ in. Above the Surface of the Sill, Fitting Snugly into a Groove in the Underside of the Wooden Sill

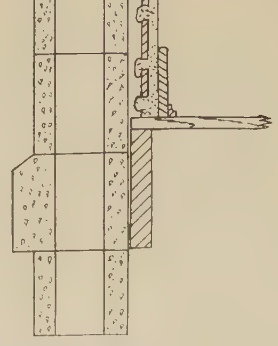


Fig. 39—The Use of the "Split" or Two-Piece Sill Is Here Shown—The Split Sill Is a Positive Protection Against Ingress of Water, and It Reduces Conductivity of Heat

Perhaps the most simple of all sills to place in the concrete wall is the "slip sill," so called because it is slipped into place at the bottom of the openings some time after the wall is erected. The slip sill is so shaped that it fits snugly into the openings, protruding portions being cast to any size and shape required. This type of concrete sill, which is equally applicable to all kinds of concrete and masonry construction, has a very decided advantage in that being placed after the rest of the wall, it may be easily kept clean and is free from most of the possibilities for injury.

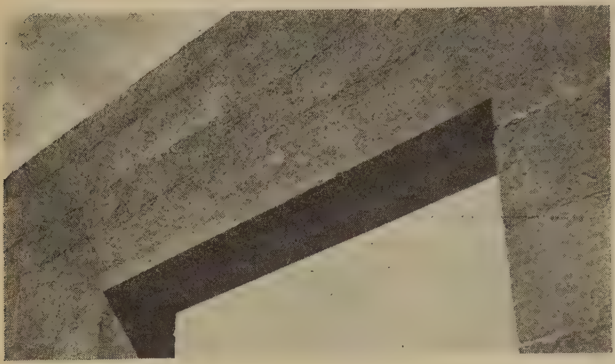


Fig. 40—Two-Piece Lintel Used Over a Door Opening—Little Extra Expense Is Involved in Making Lintels in Two Pieces, and It Is Worth More Than It Costs

The type of sill shown in Fig. 37 is perhaps the most extensively used in good residence construction, being provided with a zinc liner or water stop which fits snugly into a narrow slot in the bottom of the wooden sill as indicated in Fig. 38. This sill is simple in shape and, therefore, easy and economical to make.

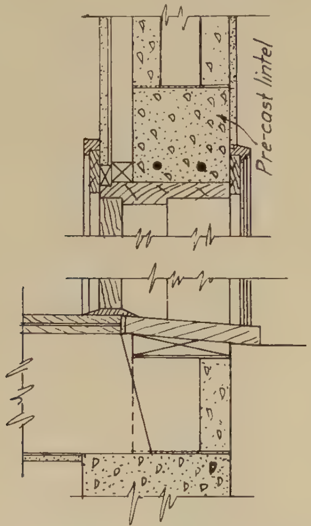


Fig. 41—Typical Outside Door Frames, Showing One-Piece Precast Lintels

Every sill should be shaped properly to run off water rather than allow it to run down on the wall; the texture should be as smooth as possible, without danger of hair cracks. Because of the danger of breakage in moving or in improper bedding, it is usually advisable to limit the length of single sill sections to 6 ft. This length should usually hold for lintels as well.

Concrete lintels are invariably reinforced with steel reinforcing rods properly placed within the units perhaps ¾ in. to 1 in. above the bottom. Where this is done the lintels must be unmistakably marked, and care taken to see that they are laid in the job top side up. In order to avoid the possibilities of trouble, some concrete products manufacturers are in the habit of casting the lintels with reinforcing rods symmetrically placed in both bottom and top. A symmetrical lintel may be placed with bottom or top up without making any difference.

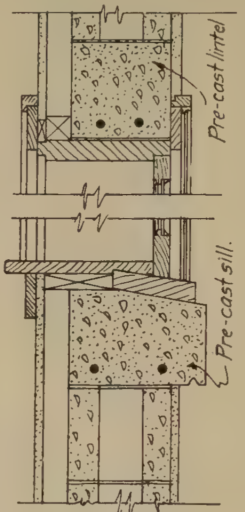


Fig. 42—Typical Casement Frames for Porch and Attic Windows—One-Piece Precast Sill and Lintel Shown

All projecting portions of concrete buildings, particularly sills, lintels and delicately traced art stone, should be boxed in or adequately protected in some other way during construction.

This issue of CONCRETE, although devoting nearly half its space to developments at the recent convention of the American Concrete Institute, gives only such high lights as seem to be most applicable to immediate practical interests of readers of this magazine. The EDITORS are glad to call attention to the fact that the complete Proceedings of the convention will appear as a considerable volume—last year more than 500 pages. It is, without doubt, the most valuable annual available to the concrete industry, whatever may be one's special interest. It is sent free to members of the Institute. The address of the Institute is 1807 East Grand Boulevard, Detroit.

Products Plant Investment, Production and Profit

When Will a Business Stand New Investment in Machinery?

By Mac Hanson

> This article was written by a concrete products manufacturer for concrete products manufacturers. This is one of several articles being prepared by this same manufacturer, considering the business end of products manufacturing. He prefers to be known as Mac Hanson—which is not his name.—Editor.

When is a concrete products manufacturer justified in spending $5,000 for new machinery?

"Be sure you're right, then go ahead" was a good, sound piece of advice in the good old days of 1919 and 1920, but little attention was paid to the first phrase then. Going ahead under forced pressure was the order of the day.

In 1922 the same rule is very sound advice, but with the heavy emphasis on the first phrase, and lots of caution on the last. Don't stop. Don't lay down. That doesn't help business in general, nor you in particular.

The Rotary Club of Chicago has had big billboards on every hand, with a slogan reading something like this: "It is the sacred duty of every citizen to do his part day by day, that business may prosper," etc. We all agree, yet the business man who goes ahead *unwisely*, at this time, is harming business instead of making it prosper. He is just adding one more to the possible list of failures. And a business failure in the present situation is worse than business in-action.

Now, as never before, the business man must study his entire situation with great care in order to "be sure he is right," and to discover how he can do business and do it at a profit.

There are many angles to this "situation," many ways out, many things necessary. First, an exact knowledge of costs will be necessary. As the margin of profit will be very small, nowadays, the business man must know absolutely and to the last cent what his products cost him placed on the market. Few of us can stand any losses, even small ones. It isn't wise. It always was poor business to price goods without knowing their exact cost. Now it is *very* poor business to do so.

Second, diversified manufacture of products will generally be necessary. You find that there is not enough of a volume of sales for the two or three lines you now manufacture, to produce a profit. It may be there is an outlet for three or four more lines of products, so that the total volume of sales from the combined five or six or seven lines, will pay a profit.

Third, curtailment of investment and a wise decision as to what little investment you do make, is a very essential factor in business success, especially in dull times. A clear understanding of the relation of investment to profits is a necessity in times like this.

There are numerous other angles to the situation, as you all realize well enough; a careful yet consistent program of well planned advertising; a study of economics of operation; a steady, persistent, yet courteous pushing of collections; interesting new capital in the business, if the business legitimately requires it, and if possible to do so, and many other factors of success come up for your study.

What considerations should determine, or limit, the amount of money to invest in plant overhead in order to produce the maximum of profit? How far can a manufacturer go, how much money can he afford to spend for machinery and equipment, to take on new lines of business, or to reduce the expense per ton or per hundred pieces on his present line by use of improved machinery?

We are assuming two premises in this discussion: First, that the chances in the present line of products are very poor for getting a big enough volume of business to make a profit. Second, that there is an outlook for some business in other lines of products if we can afford the necessary investment. The total volume of business from both the old lines and the new lines is expected to be big enough to make a profit, provided the expense of improved machinery for the established line of products, and of new equipment for the new line of products can be afforded.

That's the question. What considerations determine if it can be afforded. The first and simplest answer is that investment should be limited by the amount available to invest. The temptation is always present to over-invest, to "enlarge our business," we call it. We must always bear in mind that money used in business is of two kinds: invested capital and operating capital. As a general rule, the latter should be from four times to ten times as great as the former.

Invested capital is tied up permanently, can never be gotten hold of to operate the business. Operating capital is used to take care of all the expenses of operating or running the factory, including office expense, selling expense, etc. This operating capital is returned to us (less any losses) with every turn-over of the stock of merchandise.

Never imperil, by investing too heavily, this necessary amount of capital required for operations. Always have sufficient capital to carry your company through critical periods, before even considering any more investments. Many a business has failed because it lacked "working capital," even though the business was sound, well managed, with good prospects, etc. If you are in that situation now, you must interest new money in the business so as to get your operating capital to some normal amount.

The two points, to hold a due restraint on the desire to expand, and to keep a sufficient amount of capital available for operation, should guide you in determining how much you have available to invest.

Granting that you have (or can secure) any amount of money to invest and still have sufficient running capital, the next consideration upon which to determine the safe amount of investment, is whether you wish (or have the outlet) to do a limited business with a larger percentage of profit, or an unlimited volume of business at a small percentage of profit, though the *volume of profit* may be large. When a manufacturer limits the volume of his output, or when circumstances limit it for him, he must necessarily limit his investment. There is a certain and rather definite proportion between investment and profit in relation to the amount of business done.

For example, a manufacturer doing a $10,000 yearly business cannot afford to put $5,000 into a new machine, unless other factors, to be mentioned later, largely offset the heavy investment burden thus incurred. From my own limited experience, I would hazard the guess that the ratio of investment to volume of business should never be more than one to five, and ought to be less. Machinery investment, being only one part of the total investment, should bear a ratio of not more than one-third as great as that mentioned, and less if possible. The same statement holds true of any other part of the investment. If a manufacturer does an unlimited volume of business, his investment overhead can safely bear a greater ratio to his total volume of business.

Let us itemize the heavy investment burden of a new machine costing $5,000 installed. Figuring an average life of ten years on the machine, then its annual depreciation would be $500. Interest, at 7%, would be $350 a year. Insurance, taxes, obsolescence, contingent fund expenses, etc., would add not less than $150 more, or a total annual investment overhead expense of $1,000. If a manufacturer does an annual business of $10,000 he cannot afford to invest in machinery that carries a $1,000 annual burden.

A third factor that helps determine the amount of overhead investment is the amount of labor or other expense that will be saved. If a manufacturer had a tile machine installed that would average only a daily output of 2,000 ft. of tile with four men operating it, and could buy a machine that would average a daily output of 4,000 ft. of tile with four men operating it, he could afford to go to considerable expense to make the change, other factors being equal, for he would thus save on each 1,000 ft. of tile made 50% of his productive labor, and from 25% to 50% of his incidental and office overhead expense, and probably something on his sales expense. On the other hand, he would have increased his investment overhead expense by adding on the entire invstment overhead burden of the new machine, while still having the interest and depreciation expenses on the discarded machine to meet. This argument would apply to either the manufacturer doing a limited business or to one doing an unlimited business.

If the new machine would greatly increase the daily maximum capacity of the factory, without, however, saving any labor expense, then the manufacturer doing the unlimited volume of business could still consider the advisability of making the change, for he would still save on his incidental, office, and sales expenses per 1,000 ft. But the manufacturer doing a limited volume of business could not afford to make the change.

Let us illustrate how this works out. The annual overhead expense of the new machine, as we figured above, is $1,000. The interest and deprecation charges on the old discarded machine, let us say, total $350. Machinery overhead is thus $1,350 a year. The daily labor bill is $12 (four men at $3.00). The plant was operating 200 days a year with the old machine, thus having a labor bill of $2,400. The new machine cuts the labor bill right in two, and thus saves $1,200 a year on operating labor. Therefore, unless there were other savings, the manufacturer would lose $150 a year by buying a new machine. But there are other savings. Saving in light, fuel, oil, and other incidental expenses; savings in office expenses; savings in sales expenses—if for no other reason, then because the boss would have more time to be out on the road, etc. If these other savings exceed $150 a year, then the manufacturer can afford to buy the new machine.

There are other factors entering into the problem, but they are of special application or vary so widely in individual cases as to make the decision dependent on local conditions. Such factors are the rate of depreciation and upkeep, provisions for future expansion of the business, protection of materials, supplies, etc.

If a manufacturer has already made the fatal mistake of over-investing, there are only two ways open for him to escape business failure. He may increase his selling price or he must reduce his costs. If he can increase his selling price without losing too much of his total sales, or if he can educate his trade, without too great expense, to buy his ware at a higher price than his competitor's, then he may adopt this policy. But under any circumstances, he must reduce his costs. This he may do by increasing the volume of his annual business, which would reduce his overhead expenses per ton or per 100 pieces.

For example, let us suppose that a block manufacturer has annual sales of $10,000, being 50,000 blocks at 20 cents. His investment overhead burden, in buildings, cars, machinery, motors, grounds, etc., is $2,000. His other overhead, including salaries, taxes, office expenses, sales expenses, collection expenses, bad debts, etc., is $1,500 (makes his salary pretty small). He finds he is just turning dollars—no profit, yet no loss.

Without any further investment expense (he found himself already over-invested, you remember), he manages to double his volume of business, without adding to his overhead of salaries, taxes, etc. Labor, gravel, cement, power, etc., then cost him the same per block, but he has cut his investment overhead and other fixed charge overhead right in two. He has saved 2c a block on investment and 1½c a block on the other overhead. He thus makes 3½c profit on each block of the 100,000, or $3,500. If he only increased his volume of sales to 51,000 blocks, he would make a profit of $70.02—not much, but better than none.

The over-invested manufacturer, besides trying to increase his volume of business, should discover any leaks, and stop them, such as culls and breakage losses, bad accounts losses, unrecorded sales and theft losses. He should endeavor to make his capital turn over more quickly. This he can do by close collections and by reductions of stock, and thus increase his gross profit. He should endeavor to reduce the overhead costs of his raw materials, to effect a saving on his power and lights, and to increase the productiveness of his labor. This latter result may be obtained by use of the bonus system, by more pleasant working conditions, or some similar plans. He may possibly reduce his fixed charges by retrenchment, but this should be done with caution.

Yes, with caution and only as a last resort, because we all know that any lessening of business (which retrenchment means), is just another little bit of obstruction in the way of general business recovery, which is the goal towards which it is our sacred duty to help keep business moving.

The Editors want ideas from concrete building unit manufacturers on how they sell—how they have built up a market for their products.

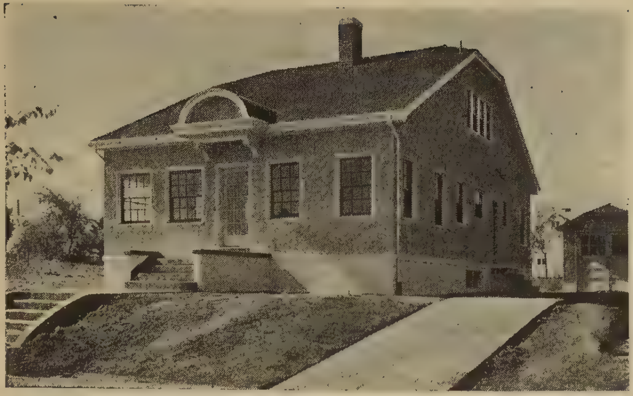


Fig. 1—The First Thermo Wall House

Thermo Wall Construction

Thermo Wall is a new concrete construction developed in Portland, Oregon, by the Thermo Wall Construction Co. It employs V-shaped steel inner form sections, of full story length between 2 x 2 wood studs, 16 m. o. c., which remain in place and outside flat steel sections 27 in. high. The removal of the inner forms leaves an air chamber between the sheds, triangular in section 14 in. wide by 4 in.

Forms are made of Armco iron. The outside forms are straight sheets with their edges bent out at right angles to form a stiffener and at the same time a place to fasten them together. These small edges are punched at eight inch intervals and four inches from each end so that the sheets are interchangeable and will fit anywhere. They are made in various lengths, all multiples of 16 inches, so that a corner can be turned at any point without specially shaped forms. These forms are placed horizontally in courses the height of one form, or 27 inches, and are secured to the inside forms by wires and spacers, making the wall any thickness desired.

In the construction of the first Thermo Wall house (illustrated), the basement wall 7 in. thick was first poured and first floor girders were put in place and the first floor joists and rough flooring were laid and the partitions were framed and put in place. Then the second floor joists were put up with the outside end resting on a temporary plate about two feet from where the outside wall of the building was to be. Then the 2 x 2 inch studding for the outside walls was set. The building was then ready for the inside forms, which were set all around the building, 48 ft. 6 in. by 29 ft., and fastened to the studs by six penny nails driven through holes in the forms. This work is reported as being done by four men in six hours.

Then the rough window and door bucks were set against the form and fastened to the studs, and a mesh reinforcing was placed. Next the first belt of outside forms was set with the top of the basement wall as a ledge to start from and the concrete pouring was started. As soon as the form was filled at the starting point, two men started to erect the second course and followed the concrete gang around the building. The same procedure was followed on the third and fourth courses.

The concrete was wheeled up onto two scaffolds at 4 ft. 6 in. and 9 ft. height, above the basement wall and shoveled or dumped into the forms. The labor required to complete the pouring of this building and erecting the outside forms is reported as eight men eight hours each and the total wall poured was approximately 1,500 sq ft.—19 cu. yds.

When the walls were three days old the inside forms were removed by two men in four hours. Outside forms were left a week when white cement stucco was applied, followed by marble chips. Had there been another story to pour the top of the outside forms would have been left in place until the second story pouring was under way to give the second story forms something to start from. The initial cost of the forms is approximately one dollar per sq. ft. of wall. Lath and plaster are applied on the projecting studs.

The actual cost of construction of the house illus-

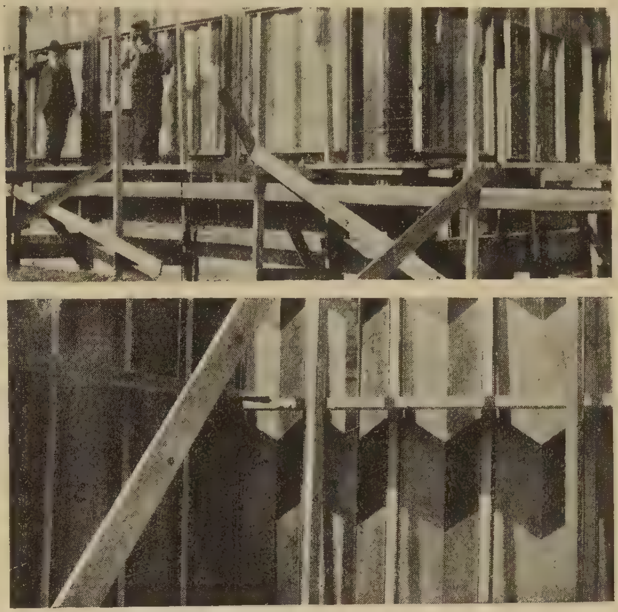


Fig. 2—Two Views, General and Close-up, of Thermo Wall Forms Being Set Up

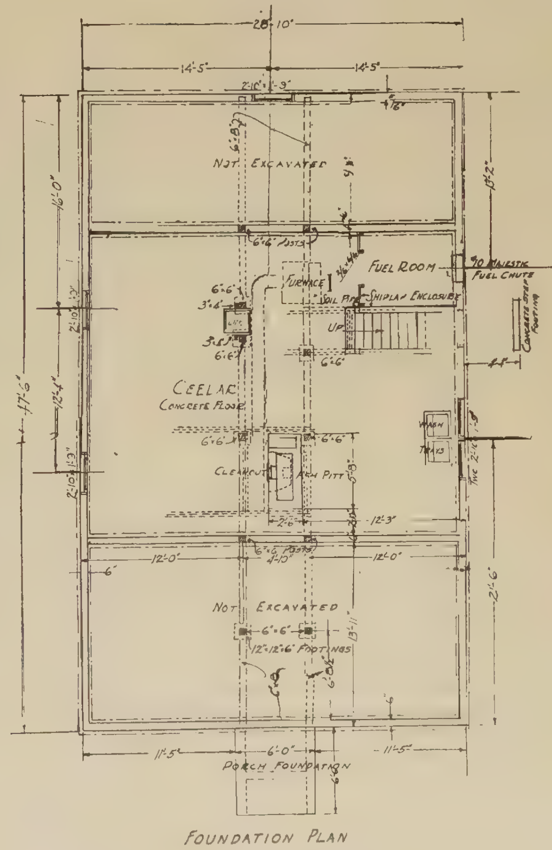


Fig. 3—Foundation Plan of First Thermo Wall House

trated is reported as $6,300. This includes a stucco garage to match the house. The house itself is complete with fireplace, breakfast nook, hardwood floors in three main rooms, vertical grain fir floors in the rest of the house, pipeless furnace and all built-in features now the vogue. Concrete steps and walks lead to front and back doors and garage.

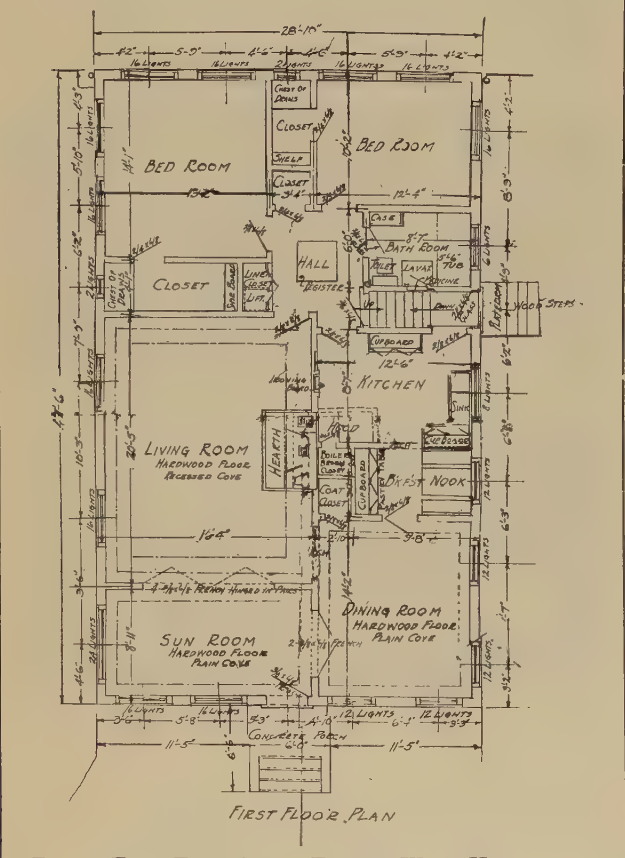
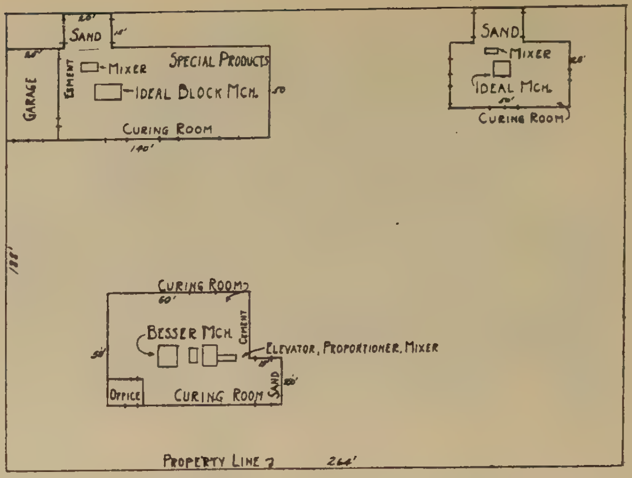


FIG. 4—FIRST FLOOR PLAN, THERMO WALL HOUSE

During cold weather the present owner of the home says that he has only to close the windows in the morning and put a small fire in the furnace to insure a comfortable degree of heat the greater part of the day. During heavy rains and winds the house showed no signs of dampness. The house has a large living room, sun parlor, dining room, two bedrooms, kitchen, breakfast nook and bathroom on the first floor. There is space for three bedrooms and bath upstairs. The Thermo Wall Concrete Construction Co. is now contemplating branching out into other sections of the country.

When some of the Ingersoll-Rand Co. people formed the Philipsburg Development Corporation, to build houses for factory operatives, it was intended that the concrete houses, built by the Ingersoll one-piece method, (described in several previous issues of CONCRETE) should be sold and rented to the foreign labor—the cheaper labor—and frame houses were built for the American workmen. However, when American workmen living in the frame houses saw the quality of the concrete houses they immediately abandoned their domiciles and took possession of the permanent construction. The result is that now the Americans are occupying the concrete houses and the foreigners the frame. This work has been under the direction of Paul R. Smith, architect and town planner.



LAYOUT OF BLOCK PLANT—ROBERT MARTIN, LANSING, MICH.

Martin Products Plant, Lansing

The Martin Concrete Block Co., Lansing, Mich. (see plant layout sketch), is attaining considerable success in the manufacture and sale of concrete blocks, particularly face blocks with a fine granite finish.

The plant is equipped with one Besser and two Ideal power machines, which give it a capacity of 3,000 blocks per 10-hour day. The plant is also equipped with Simplex chimney block machines, and some facilities for turning out coping and trim stone.

The aggregate is hauled to the plant from a nearby pit by local teamsters, paid a certain price per load. It is dumped in the driveway on the side of each building. In the plant containing the Besser machine it is first screened through a 1-in. screen to remove all large pebbles, and then lifted to a small storage bin by a bucket elevator. It is then fed by gravity to a Kent proportioner and continuous mixer. The cement is added by hand from a platform along the side. The mixture used on the common blocks is 1:5.

The facing mix is prepared by hand in a wooden trough and kept in buckets by the side of the operator, who uses a small scoop to shovel it in the mold.

Materials are handled by hand in the other two plants and are mixed in Blystone mixers. In all cases the off-bearers carry the blocks on pallets to the curing rooms, where they are kept wet for 48 hours. They are then carried to storage in the yard on special wheelbarrows, constructed in the plant, that hold nine block to the load.

The company makes a face block of fine appearance, using a 1:2 mix of cement and fine granite chips, with waterproofing, to the amount of 1½ lbs. to the sack of cement, mixed in. After the block is removed from the machine it is subjected to a very fine spray that brings out the texture. About 400 of these are manufactured a day.

During the summer Mr. Martin has two trucks and two teams hauling block all day. He pays them at the rate of 2½ cents per block.

He tries to have all his work done at a piece rate, so that he knows at all times his production cost. He endeavors also to have his trucking done at a piece price, so as to cut down the capital invested in the business.

His product is guaranteed. He replaces all block that break. All the people in town are acquainted with his product, and he has no difficulty in disposing of it.

American Concrete Institute Convention

(Continued from page 106)

Concrete Products

Fire Tests of Block

The most important, immediate and practical development of the Institute convention for the manufacturer of concrete building units was the report of Committee P—5, Fire Resistance of Concrete Building Units, and the action on that report by the Institute's Board of Direction.

The committee presented a comprehensive outline of a test program worked out in co-operation with the Underwriters' Laboratories, Chicago, to establish the fire-resistance of concrete block. The tests are to be a basis for an insurance rating by which block manufacturers should benefit handsomely if they make block up to a standard to be established by the tests. This standard will be definite, and should separate the sheep from the goats among block manufacturers, to the great benefit of the sheep. The tests will cost about $6,000.

Convinced of the fundamental value of such tests to the public, and more especially to such concrete products manufacturers as are really trying to make good building units in competition with low grade products—(between which the general public is not always able to distinguish)—the Institute's Board of Direction appropriated $500 as the nucleus of a fire test fund and authorized Committee P—5 to secure pledges of the full amount necessary for the work and to oversee the tests. About $700 for this work has already been pledged, through the efforts of the Concrete Products Association, and this is to be available as a part of the general fund. Many pledges have, however, been very small, in view of the far-reaching importance of the tests to the business. The results mean many thousands of dollars of value to individual corporations dependent on the development of concrete products manufacture, and Committee P—5 will expect to receive pledges based on a larger conception of the undertaking. Pledges should be made to the "Concrete Building Units Fire Test Fund," and should be sent to Harvey Whipple, Treasurer, American Concrete Institute, 1807 East Grand Boulevard, Detroit. Mr. Whipple is serving also as Secretary of Committee P—5, of which Leslie H. Allen is chairman.

* * *

What Strength for Block, Brick and Tile

Discussion following the presentation of the report of the nIstitute's Committee P—1 on Standard Building Units, proposing new standard specifications for concrete block brick and building tile, did not get anywhere because the two opposing factions were unable to arrive at a compromise. The discussion itself was degraded in value by the personal element in it and as a result the Institute lets another year slip by without standards which are much needed.

The split is on strength requirements. The committee's majority report provided:

> 4. *Ultimate Compressive Strength.* (*a*) Hollow and solid concrete block, two piece building block brick and building tile for load bearing and exterior walls.
>
> The ultimate compressive strength of such units when delivered to building site or at twenty-eight (28) days must average not less than 1,000 lbs. per square inch of gross cross-sectional area of the unit, as used in the wall, and must not fall below 700 lbs. per square inch in any test.
>
> (*b*) Solid or hollow concrete block, two piece block, and building tile for non-load bearing and partition walls.
>
> The ultimate compressive strength of such units when delivered to building site or at twenty-eight (28) days must average not less than 300 lbs. per square inch of gross cross-sectional area of the unit, as used in the wall, and must not fall below 200 lbs. per square inch in any test.
>
> 5. *Gross Cross-Sectional Area.* (*a*) Concrete block, brick and building tile. The gross cross-sectional area shall be considered as the product of the length by the width of the unit. No allowance shall be made for the air space of hollow units.
>
> (*b*) Two-piece concrete block. The ultimate compressive strength in pounds per square inch of gross cross-sectional area of each unit as used in the wall shall be regarded as the ultimate compressive strength of the unit divided by the product of the length in inches times one-half the thickness in inches of the wall for which the block is intended if the units are equal in area. When the units are not equal in area, the combined ultimate strength of each pair of units shall be divided by the product of the length in inches of one block times the full thickness of the wall for which the blocks are intended.

Such regulations, according to the minority (and the minority view has gained enough strength to be formidable as a possible majority) immediately rule light-weight tile out of the field. The minority report is quoted in part as follows:

> The minority consider the specifications, as drafted, to be incomplete, wrong in principle, in a form not acceptable to the various building departments, and injurious to the concrete products industry, if permitted to be spread broadcast with the endorsement of the American Concrete Institute.
>
> As to substance, the minority contend that the specifications as drafted, rankly discriminate against light-weight structural units, which are commonly designated concrete building tile. If the specifications as recommended by the majority are to be adopted and are to be strictly enforced, concrete building tile would be cut out of the two most prominent fields of construction, which are small residence and small building construction, such as garages, one and two-story office and commercial buildings, etc., and on the other hand the heavier load construction, such as four and five-story apartment houses, factory buildings, etc.
>
> The majority are not in favor of reducing the quality of concrete permitted to be used in structural units. On the contrary, we are in favor of increasing the requirements as to quality, so as to necessitate the use of a quality of concrete which cannot but prove satisfactory. All that we ask is, that the test be applied scientifically with respect to the practical characteristics of the units.
>
> The majority report places all units, regardless of characteristics, on the same basis, namely: a flat test of 1,000 lb. per sq. in., with permissible testing as low as 700 lb., provided the average be 1000 lb.
>
> With respect to quality of concrete, we recommend that all structural units, other than brick, shall average 1500 lb. per sq. in. of net section with no one test falling 10 per cent under 1500 lbs. We know of no other structural material that is allowed a variance of 30 per cent, as proposed in the majority test. We regard that as unnecessarily lenient and as setting a standard of permissible variance which should not be set.
>
> We contend that the application of the 1000 lb. gross area (one standard) specifications to all classes of concrete products, automatically eliminates light-weight building tile units, which hold the greatest promise for future development in the entire field of concrete structural units. Take, for example, small building constructions, such as residences, etc., which is a field in which the heavier type of concrete unit as represented by the concrete block, has in the past years obtained less than 1/10 of 1 per cent of this class of construction. This, as every one who has had any familiarity with the promotion

of concrete units, knows, has been due to the heavy weight, excessive cost and inferior quality of concrete used.

Effort to promote the use of concrete block for house construction, taking results as a whole, and conditions throughout the country as a whole, has been a dismal failure.

We believe, as in fact do most men in touch with concrete structural unit development, that concrete units properly made, for repective intended use, can serve the entire field of masonry construction, whether same be in the class of heavy duty masonry construction—wherever clay brick masonry is used—which may be six stories in height down to the smallest light wall construction, such as one or two-story residence, commercial buildings, garages, etc.

The class of concrete structural units, known as concrete building tile, is a type of unit designed to be used as a brick replacement unit, and which, because of the character of its design, can be varied as to compression strength, so as to cater to either the heavy loading or light duty fields.

The heavy duty wall may, perhaps, be loaded from 150 to 200 lb. per sq. in., while smaller buildings seldom require over 20 to 30 lb. per sq. in.

It is, in the opinion of the minority, ridiculous to assume that only one type of concrete product shall be made to serve either the one field or the other. To require a heavy duty building tile to be made, where it is intended to be used only in light duty walls, is to impose a tremendous handicap upon building tile, and would practically eliminate same from consideration in competition with clay products and lumber.

On the other hand, to say that the strength requirement shall be 1000 lb. per sq. in. gross area, as such provision is usually interpreted, means that with the tile unit confined to a safety factor of either 8 or 10, would limit it to either 100 or 125 lb. per sq. in permissible loading. It is obvious that this would cut tile out of the very desirable heavy duty loading, which, as stated, may run from 150 to 200 lb. per sq. in., and for which the tile unit can be scientifically strengthened.

While these specifications are not intended as building code standard, the minority wishes to point out that it only remains for a factor of safety to be added to the specifications to create what is a building code regulation as regards allowable loading.

We illustrate a few of the outstanding flaws in the 1000 lb. gross area specifications, and what same will mean if adopted as the prevailing view of the American Concrete Institute.

Suppose, we assume, a factor of safety of 8 will be applied in building regulations as regards the 1,000 lb. gross area section, this would mean that concrete products could be loaded up to 125 lb. per sq. in. and no more. No more for the reason that if the concrete industry does not regard concrete units as capable of meeting a more severe test, its enemies are certainly not going to permit any higher rating to be given.

Concrete products, whether they be solid or hollow (cored) construction, averaging 1,500 lbs. per sq. in., should be permitted to carry loads 50% in excess of the 125 lbs. limit, but the 1,000 lbs. gross area specifications would close the door to this in any construction which required loading in excess of 125 lbs. per sq. in. It is obvious that if the factor of safety should be placed at 10 then 100 lbs. loading would be the limit, while the usual allowable loading on clay brick is 200 lbs. per sq. in.

On this point it is the contention of the minority that the specifications should recognize specifically that concrete units exist and can be developed to produce a structural unit at a competitive cost with other materials, which can stand up to 200 lbs. per sq. in. loading.

On the other hand, it may be desirable to build a small building of a unit which is 8 or 12 in. in wall width, having say 60% net load carrying section, the same testing 1,500 or 1,600 lbs. per sq. in., such unit could not meet the required 1,000 lbs. gross area test, and would be rejected, even though it undoubtedly would have a factor of safety as regards loading of at least 40 and possibly even 100.

There have been manufactured for several years structural units which have only from 20 per cent to 33 1/3% net section. Four such types of well known commercial structural units, all coming within the class of what is known as building tile, were offered by the minority as evidence of its position at one of the committee meetings, in order to show the merits of same, and likewise how impossible it would be to commercially make any of these units stand the 1,000 lbs. gross area test.

The Detroit building department has permitted their use wherever brick were used, and have permitted the loading up to 200 lbs. per sq. in. net section, but taking this same tile which has been used with such complete satifaction for so many years on the 1,000 lbs. per sq. in. basis, and realizing that there is only 25% net section, this same tile would have to stand 4,000 lbs. per sq. in. Recognizing the fact that a structural unit will not test up to its full concrete strength would mean that the concrete of which the tile was manufactured would have to be made to stand at least 5,000 lbs. per sq. in., consequently the 1,000 lbs. gross area test would absolutely eliminate this tile in its light-weight shape, and would compel the makers thereof at least to double the web thickness of the tile.

Of the three other types shown to the committee, each one would likewise have to have more than double its web thickness, or else its manufacture would have to stop.

While the 1,000 lbs. gross area method would permit a loading of 500 lbs. per sq. in. net section on the above tile, providing they met the 1,000 lbs. gross area test, probably more than would be conservative, the type of construction in which they are intended to go, would probably require less than 30 lbs. per sq. in.

The minority further contends that it is possible in requiring a 1,500 lbs. minimum strength, or net section test, to insure a good grade of concrete. It is a better guarantee of a higher quality concrete than is the case with the 1,000 lbs. gross area allowable by the majority report, which even may fall as low as 700 lbs.

It is the opinion of the minority that the gross area test is unscientific, is not in accord with sound practice, and is entirely at variance with the method of computing stresses as regards other classes of building material, such as steel, reinforced concrete., etc. The preferred method of specifying the strength requirement for structural units is a net section basis, with a factor of safety of 8 or 10. This for a 1,500 lbs. quality of concrete, would permit a loading up to 187 lbs. per sq. in. for each square inch of net section.

How this would work can be simply demonstrated. In the case of solid block, etc., the loading on gross area would be a permissible loading of 187 lbs. per sq. in. Where, however, the load carrying section represents only one-third of the gross area, the allowable loading would be only one-third of 187 lbs., or 63 lbs. per sq. in. gross area, and so on.

However, the minority is not insistent upon its point of view regarding the net section, if general opinion does not sustain same. It does contend, however, that if the gross area method of testing is to be retained, then there must not be less than four classes of tests in order to cover a wide range of products in the various construction fields. These may be designated as follows:

Class	Compressive Strength Per Sq. In. Gross Area	Allowable Loading
Heavy bearing	1200	150
Medium bearing	800	100
Light bearing	480	60
Non-bearing	250	Sufficient to permit handling

A Proposed Compromise

In further discussion, John W. Lowell submitted a proposed compromise specification providing, with respect to the debated points, as follows:

3. Concrete block, brick and building tile must be subjected to compression tests. Where such products are to be exposed to the weather, they must be subjected to (a) compression tests, and (b) absorption tests.

4. Ultimate Compressive Strength

Concrete block, brick and building tile.

The ultimate compressive strength of such units at the time when laid in the wall, or at twenty-eight (28) days must comply with the requirements set forth in the following table:

Unit	Compressive Strength Requirement of Unit in Pounds per Sq. In. of Gross Area		Allowable Load—lbs. per Sq. In.
	Ave. of All Tests	Individual Min.	
Brick	1500	1200	250
Heavy bearing block or tile	1200	1000	200
Medium bearing block or tile	700	500	75
Light bearing block or tile	500	400	40
Non-bearing block or tile.	250	....	Sufficient to handle

In no case shall concrete for block or tile for bearing wall construction have a compressive strength of less than 1,000 lbs. per sq. in., based on the net area of the block or tile as used in the wall.

Culvert Standards Progress

The report of Committee J—2, on Concrete Pipe, presented by B. S. Pease, chairman of the Institute representation, reviewed briefly the great need felt by practically all parties interested in concrete pipe, whether they be manufacturers, designers, or users, for coming to some definite conclusion as to designs, tests, etc. A thorough understanding of the governing features means elimination of unnecessary expense, and at the same time assuring the required strength. The history of the committee activities from the time it was formed, and its program laid out, in 1919, was reviewed.

The committee reports that a careful study of the subject very soon brought the entire committee to realize that before much if anything could be done toward standardization of design, etc., it must be known what is to be expected in the way of loads that might come upon the pipe.

The work of the Engineering Experiment Station of the Iowa State College, at Ames, Iowa, in studying the question of loads on pipe in ditches, is referred to in the report. These tests, so far, may be divided into two general classes: (a) those based on determining loads from embankment, as ordinarily built, and (b) from first building the embankment to partial height, then excavating the ditch in which the test pipe are placed, refilling the ditch and then the balance of the embankment placed as before.

As a result of these tests, a considerable amount of data has been collected, but the committee feels that additional work should be done along this line before making definite recommendations. Further studies are being made at the Experiment Station, and results so far secured will probably be published in a bulletin, which will be in the form of a progress report, with tentative suggestions.

The following reports of sub-committees have been adopted as tentative:

Sub-Committee No. 1—Classification and Loading Requirements

1. It is recommended that a class be established in which the ultimate strength of the pipe by the sand bearing test in pounds per foot of length of pipe shall be $2,250 \times D$, where "D" is the nominal internal diameter of the pipe. (This class was not designated, but was referred to as class "2250D.") This is the pipe designed for ordinary highway purposes under fills up to 12 ft. high.

2. It is recommended that a class be established in which the ultimate strength of the pipe by the sand bearing test in pounds per foot of length of pipe shall be $3,000 + D$, where "D" is the nominal internal diameter of the pipe in feet. (This class was not designated, but was referred to as Class "3000D.") This pipe was intended for ordinary minimum requirements of railway practice.

Sub-Committee No. 2—Design

1. It is recommended that the classification loads referred to by the Classification Committee shall be used as a tentative basis for the design of pipe.

2. It is recommended that no visible cracks shall appear under the test loads at a loading two-thirds that of the ultimate for pipe 24 in. in diameter or at 50% of the ultimate for pipe 84 in. in diameter; intermediate diameters to carry proportional percentages of the test load.

3. It is recommended that the minimum covering for the reinforcing steel be ¾ in. from the face of the steel to the nearest face of the concrete.

Sub-Committee No. 3—Methods and Requirements of Tests

Specifications will be prepared covering portland cement, fine and coarse aggregates, reinforcement and other materials entering the construction of reinforced concrete pipe. Whenever possible, the committee will adopt specifications of materials that have been standardized.

It is recommended that the committee adopt the relation between three-point loading and sand loading tests of the American Society for Testing Materials.

Sub-Committee No. 4—Workmanship and Installation

1. It is recommended that specifications prepared by this sub-committee be in the nature of an addenda providing advice to engineers.

2. It is recommended that the portion dealing with manufacture be confined to finished product with the following provisional additions:

(a)—Hydration.

(b)—Age before transporting.

(c)—Methods of loading for shipment.

3. It is recommended that the portion dealing with laying outline recommended practice and co-ordinate such methods with the strength requirements provided by the other sub-committees.

* * *

Concrete Pipe, Drain Tile and Conduits

Committee P—7 on Concrete Pipe, C. F. Buente, chairman, has effected a more complete sub-division of the work assigned to the committee as follows: (a) Plain Concrete Pipe; (b) Reinforced Concrete Pipe; (c) Concrete Pressure Pipe; (d) Concrete Irrigation Pipe; (e) Concrete Drain Tile; (f) Concrete Conduits.

No work is to be undertaken at the present time on the subjects of pressure pipe, irrigation pipe and concrete conduits.

The following recommendations are included in the report:

The adoption by the Institute of the Standard Specification C-14-20 of the American Society for Testing Materials for Cement Concrete Sewer Pipe and also the adoption by the Institute of such parts of the Standard Specification C 4-21 of the American Society for Testing Materials as relates to the manufacture of concrete tile.

In relation to reinforced concrete pipe, the committee recognizes in principle the value of classified standards for this commodity, the classes to be of as small a number as will economically cover the demand for this type of pipe. With this principle in mind, the committee has now under discussion the fundamentals in relation to the problem of reinforced concrete pipe. It will bear in mind the fact that the Institute is represented on the Joint Concrete Culvert Pipe Committee, and will endeavor to conform to the action of that committee as it affects pipe for use in culverts.

The committee hopes, within the present year, to complete its work in the preparation of a tentative specification for reinforced concrete pipe, and to begin work on some of the other subjects that have been so far postponed.

* * *

Building Units Market

W. D. M. Allan presented a paper outlining the possibilities of the present and future market for concrete building units emphasizing the necessity for care as to the permanence and dependability of concrete block and other concrete building units.

Contractors' Field Problems

Proportioning Concrete—Laboratory and Field Tests

The method of obtaining a plastic mixture with a smaller amount of water by grading the aggregate as coarsely as possible, was discussed by Prof. Duff A. Abrams, preliminary to a practical demonstration of steps in designing and testing a mix. Plasticity is very necessary for the proper placing of concrete, the water being added to the concrete mix for two purposes: (1) to supply water for the hydration of the cement, and (2) to produce a plastic mixture. The amount necessary for hydration of the cement has not been definitely determined, but it is not as much as is required to make the concrete plastic.

The slump test was outlined as being the most generally used for measuring consistency, because of its simplicity. The need for research for a practical way of determining plasticity was pointed out.

On building construction the importance of control of water should be brought home, since excess water often produces concrete with a strength only 20% or 30% of what it should have been, and only 60% of the values used in design.

The practical demonstrations were given by Stanton Walker, Structural Research Laboratory, Lewis Institute, Chicago, covering the method of making a sieve analysis; of determining the unit weight of concrete; of making colorimetric tests for organic impurities in sands; discussion of and calculation for selection of proportions of materials required to produce concrete of a given strength; calculation of quantities of materials required for a cubic yard of concrete; mixing a batch of concrete, using the slump test to determine the water content, and molding test cylinders. It proved to be one of the most interesting sessions of the convention.

* * *

Chuting vs. Wheeling

The report of the Institute's committee on Contractor's Plant for 1922 is divided for convenience into four parts:

(1)—A consideration of the factors that govern the choice of wheeling or chuting equipment as a means of placing concrete;

(2)—A re-study of last year's charts, which were made when conditions in labor and material market were abnormal;

(3)—A new set of charts similar to those published in the 1921 Proceedings, but based on the more normal condition existing at the present time in the material and labor markets; and

(4)—Descriptions of a number of recent jobs, with notes on plant layout and investment, operating costs, etc.

The broad question of when chutes may and may not be used with economy, has been made the principal part of the report abstracted below.

Labor rates have been reduced to $4.50 for 8 hours, as wage scales throughout the country have been generally established at new and lower levels.

Section 1. Analysis of Chuting and Wheeling Plants

The principal problem facing a contractor in his decision as to what kind of plant to use on a certain concrete structure is in choice of the means of placing concrete by means of wheeling or chuting. This decision once properly made, the other details of plant layout such as location of plant or arrangements for receiving materials, may be properly determined by similar method of analysis for either case.

The effectiveness of wheeling is limited chiefly by the distance which it may be necessary to wheel from the mixing plant.

Starting with the lowest cost for placing concrete in front of the mixer, the labor cost per cubic yard will rise with each addition to the haul.

Chuting Plants of Two Types

Chuting plants are of two general types. The self-contained type, usually of about 100′ radius, is hung from the hoist tower direct by means of a suspended boom and counterweight chute. In the older or "line chute" method the chutes are suspended from a cable run between towers or between towers and anchorages.

The plant investment and installation cost, however, will vary with the distance to be spanned, for since the slope of the chutes with reference to the horizontal cannot be reduced below a certain fixed angle it follows that for long reaches there must be added to the cost of the extra length of chute a charge for the corresponding increase in the height of the tower.

Among other factors affecting the choice between the two methods of placing may be mentioned the character of the building; the cost of freight and repairs, the interest on investment and the kind of equipment which is available, as well as the amount of experience which local labor has had in concrete construction.

Chutes do not lend themselves as readily to all types of buildings, and it is here principally that the study is necessary. A nearly square structure is obviously best adapted for the 100 ft. radius type. The building should preferably have a high yardage or a number of stories, although "H" or irregular shaped buildings which may be enclosed in an approximate square can usually be handled as advantageously. Long narrow structures one or two stories high with low yardages are not adapted for this method of placing. With the same plan of building, but with greater yardage and more floors, one 100 ft. radius plant may be used to pour part of the building and by chuting to a floor hopper out 100 ft. off the wheel required to reach the rest of the building. Two independent 100′ radius plants may be used, or one mixing plant, a line chute to a re-hoist tower, and 100 ft. radius plants mounted on both towers.

The first step is to find out whether the job is one to which chutes will lend themselves without forcing. If by a general inspection of the conditions such is found to be the case, it is then proper to outline a plant layout for each method of placing and make an analysis of the advantages and disadvantages of each.

Costs Involved In Choice of Plant Type

The next step in the decision as to which type of plant is economical and suitable for a certain piece of work is to determine as accurately as possible the cost of each so that the one giving the lowest ultimate cost of mixing and placing concrete may be selected.

This ultimate cost may be separated for the purpose of analysis into the following items:

1. Rental of Plant Involved.
2. Installation—Labor and Material.
3. Maintenance of Plant—Labor and Material.
4. Operating Cost of Plant—Labor and Material.

These four items will be explained more in detail as follows:

Item 1, Rental of Plant, is arrived at in several different ways by different contractors. The simplest, though not the most economical to the job, is to purchase suitable plant at the beginning of the work and sell it upon the completion of the job, and the difference between the purchase and the sale price then represents the charge to be made as rental of plant. This method of handling plant has several disadvantages other than lack of economy,—such as is the case in time of industrial expansion when suitable machinery might not be immediately available at the beginning of the work, or a period of depression at the end of a job, making it impossible to dispose of the plant without a great sacrifice.

The usual way to handle this account is for a general contractor to maintain a suitable plant yard and charge each job a rental for the items of plant furnished to the work. The amount of rental depends upon the value of the machinery and the rapidity of its depreciation and varies generally from 5% to 15% per month of its initial value. Motors, engines, hoists, etc., with proper maintenance, will not depreciate in value more than 5% a month. Mixers, boilers, etc., will depreciate 10% per month and concrete carts, chutes and like items of plan will depreciate up to 15% per month. Other smaller items, such as belting, shovels, wheelbarrows, etc., which are apt to be used up or destroyed during the life of an average job, are not generally considered as plant but as supplies and are bought by the job and any salvage value which they may have upon the completion of the work is credited to the part of the job for which they were purchased.

Where dealers are depended upon whose business it is to rent out plant and where this practice is followed, the average cost to the job is about 10% per month of the value of all machinery furnished.

The transportation of the plant including freight, trucking, loading and unloading, both to and from the job, is a proper part of the plant rental item.

Item 2, Cost of Installation, includes all charges for labor and material entering into the setting up of the machinery at the beginning of the work and includes the construction of storage bins, cement sheds, hoist towers, floor hoppers, run panels and such miscellaneous items as really form a part of the completed plant for mixing and depositing of concrete. This cost of installation also includes any additions to this plant or changes in the arrangement of the same which may be necessary during the operation of the job and also includes the cost of taking down the plant upon the completion of the work.

Item 3, Maintenance, includes the cost of all labor and material used in maintaining the plant in good working order such as repairs to bearings and other worn parts of machinery, painting and cleaning at the termination of work. To this item as also charged the cost of replacing parts broken during the life of the job.

Item 4, Operating Cost of the Plant, is principally a labor charge, the only material entering into it being the cost of fuel, water, lubricating oils, waste, etc., and electric power in case electricity is used instead of steam. The labor in this item includes the actual operatives of the plant such as engineers, firemen, hoist runners, mechanics, etc., as well as the force of laborers employed in charging the mixer with the materials of concrete, and the larger force of laborers employed in moving run panels or chutes, and those actually placing the concrete in the forms, whether it be by carryalls or chutes.

CHOICE INFLUENCED BY LABOR SITUATION

Serious shortage in the labor market or a necessity for extreme speed in placing concrete, may influence the choice of plant as normally selected. The actual value of these two conditions can generally be determined with sufficient accuracy so that a proper weight may be given to their influence in changing any layout of plant normally decided upon.

Principal among the items common to both wheeling and chuting systems will be:

Towers and guy lines.
Mixers.
Hoist drums.
Hoisting buckets.
Electric motors or steam engines and boilers and electric wiring or steam piping.
Concrete carts.
Floor hoppers, gates, etc.
Run panels with horses, etc.

In the case of a wheeling job, large numbers of carryalls will be used, with their necessary run panels and supporting horses, sufficient to reach the most remote parts of the works. There will probably be a single drum type of hoist used, and the hoist tower and floor hoppers will be built of wood. The size of the wheeling gang must be determined for the whole job, as that sufficient to take care of a little more than the average haul, which will be half way from the tower to the most extreme part of the building. The charging and placing gang will remain about uniform throughout the job.

In case a chuting plant is decided upon, the special equipment will be about as follows:

Steel tower, with base and head frame.
Sliding frame, with hopper.
Boom and counterweight truss.
Extension chutes.
Special hoist bucket.
Intermediate hoppers or additional sliding frame and hopper.

It is seldom found feasible to chute to all the remote points of the building, and the increasing objection on the part of engineers to the direct placing of concrete in the forms from chutes will tend to the use of floor hoppers and a short haul by carryalls, with the resulting use of a smaller number of carryalls and floor panels, rather than the elimination of the same.

The charging and placing gang will be about the same as where chutes are not used. The actual operators of the plant, such as hoist runners, firemen, etc., will be about the same, whether the concrete be transported by chutes or by carryalls. The cost of power, whether steam or electricity, is considerably greater for the chuting than for the wheeling plant, due to the increased hoist necessary.

If due to special conditions, such as the necessary transportation of considerable quantities of concrete long distances, it is decided that line chutes are more suitable; the special equipment will consist of, principally:

Main hoist tower, generally of steel and of greater height than for either of the other layouts.
Auxiliary towers or heavy anchorages.
Line chutes and heavy supporting cables.
Special auxiliary chutes, with gates, taking off from the line chutes.
Special hoist bucket.
Heavy guy lines and anchorages for towers.
Heavier hoist equipment.

SUMMARY OF COMPARATIVE COSTS

The summary of the cost of each type of plant will shape up about as follows when all items are considered, it being understood that the specific items of equipment given below are only for an example.

I.—PLANT

Wheeling		*Chuting*	
Equipment	Depreciation	Equipment	Depreciation
Mixer, 1 yd................	20%	Mixer, 1 yd................	20%
Motor, 75 h. p.............	20%	Motor, 75 h. p..............	20%
Single drum hoist..........	20%	Double drum hoist.........	20%
100-ft. wood tower—ft. B.M. lumber at $—per M......	100%	180-ft. steel tower..........	20%
Tower hoppers—ft. B.M. lumber at $—per M..........	100%	1 additional sliding frame, with 54 ft. straight back hopper	20%
Run panels and horses—ft. B. M. lumber at $—per M.	20%	600 ft. ¾-in. hoist cable...	50%
1 yd. hoist bucket.........	50%	3,700 ft. ⅝ guy cable......	50%
350 ft. ¾-in. hoist cable at.	50%	20 turnbuckles	
1,500 ft. ⅝ guy cable at....	50%		
12 turnbuckles			
Wiring or piping..	100%		100%
Concrete carts at............	50%	Sliding frame with boom and counterweight truss plant complete	20%
		Blocks and tackle for boom.	5%
		Blocks and tackle for truss.	5%
		For moving sliding frame, 1,080 ft. ¾ cable at.....	50%

Also include bins, bulkheads, conveyors, elevators, or other mechanical equipment forming part of setup. Usually these items will apply equally to wheeling and chuting plants.

Interest on investment at 7%, ...months.

II.—INSTALLATION

Excavation for grading for mixer, plus sheeting and backfilling.

Setting up and dismantling motor, mixer and hoist.

Wheeling	*Chuting*
Building and dismantling wood tower.	Erecting and dismantling steel tower, rigging, chutes.
Making run panels and horses.	

Erection and dismantling of bins, bulkheads, conveyors, etc.

Electrical, plumbing, and steamfitting work to connect up plant.

III.—MAINTENANCE

Wheeling	*Chuting*

IV.—OPERATING

Wheeling	*Chuting*
Fuel or power oil and waste.	

Labor mixing, hoisting and placing:
  Men charging mixer.
  Men handling cement.
  Men on mixer.
  Hoisting engineer.
  Fireman (if any).
  Man on tower hopper.

Wheeling	*Chuting*
Men wheeling on floor.	Men in chutes.

  Men spreading and tamping.
  Foremen.

SECTION 2

It was pointed out in last year's report of the committee that the arrangements of plant most frequently used in building construction can be classified as modifications of seven general types.

To avoid the labor of repeated estimates of the cost of layouts for different yardages, it was suggested that the cost of each of these arrangements be platted in the form of a chart, from which the cost per yard for plant and installation could be readily obtained.

The new charts from which the cost per yard for plant and installation of the seven general types can be readily obtained, are figured as follows:

(1)—For each layout two sets of estimates have been prepared, one for wheeling plant and one for chuting plant.

(2)—As a 1-yd. mixer is rarely used for jobs of less than 4,000 yds., a ¾-yd. plant has been used for all jobs below this figure, and a 1-yd. plant for all jobs above it. This makes a horizontal break in the charts at the 4,000-yd. mark.

(3)—For jobs of less than 4,000 yds. the equipment used for mixing, hoisting and placing is assumed as ¾-yd. mixer, 1-yd. hoist bucket, single drum hoist, 50 h. p. electric motor, 50 ft. wood tower, 8 concrete carts, and 300 ft. of run panels.

For jobs of more than 4,000 yds. it is assumed that there would be used 1-yd. mixer, 1-yd. hoist bucket, single drum hoist, 75 h. p. electric motor, 125-ft. wood tower, 12 carryalls for placing and 400 ft. of run panels.

Chuting equipment for jobs of all sizes is assumed as 1 yd., of the so-called "100-ft. radius" type, with which a double drum hoist would be used for convenience in raising and lowering the sliding frame. A ¾-yd. mixing plant would probably require not over a 10-ft. tower. For a 1-yd. plant a 180-ft. tower is commonly used.

These assumptions are for an average of several conditions of area and height for a given yardage, and will therefore be likely to give a cost which will vary slightly from the cost obtained by actually figuring out a specific job. For this reason the final decision on any large job should be made from a special estimate, rather than from the charts, as a small difference per yd. will become quite important in the case of large yardages.

(4)—Cost of plant to the job has been figured on a depreciation basis. The schedule below is reprinted from last year:

Bucket elevator	40%
Carryalls	50%
Concrete bucket	20%
Hoists	20%
Mixers	20%
Motors	20%
Side tip cars	20%
Steel hoist tower	20%
Stiff-leg derrick	20%

These figures were considered suitable for jobs of over 4,000 yds., running 9 months to 1 year. On the ¾-yd. plants (jobs of less than 4,000 yds.), the depreciation has been taken as 60% of the annual figure in the table.

Framed structures, such as bins, bulkhead, wood hoist towers, etc., were considered a total loss, and the plant charged with their full value.

Intallation—Under installation was charged labor required to set up and dismantle the plant, as well as labor making up run panels, wood tower hoppers, conveyor supports, etc. Erecting steel hoist tower and hanging concrete chutes the first time is an installation charge. The subsequent moving of chutes about the floor, or the lifting of the sliding frame on the tower from floor to floor, are charges against concreting.

Power, etc.—Power or fuel, oil, waste, grease, etc., have been included in the form of a flat charge of .12c per yd. of concrete. This has been added to the labor unit for mixing, hoisting and placing.

Interest on investment should be figured at 7% per annum on the value of the mechanical equipment put on the job. Framed structures are not carried by the contractor, but, like the form lumber, are bought for and used up on the one job, and the cost of framed structures becomes a part of the cost of the work. The period for which interest is figured will vary with the period for which the plant is on the job. It may either be put into the chart for an assumed average period, as was the depreciation, or it may be added in the summary.

To the total cost for plant must be added the labor cost for mixing, hoisting and placing.

Labor, mixing, hoisting, and placing embraces, broadly, the gangs charging and running the mixer, the hoisting engineer, man on the tower hopper and the floor and floor gang. The floor gang includes men wheeling, spreading, and tamping, as well as labor to lay and shift run panels or move chutes.

Time spent on receiving aggregate or cement is not included. It has been taken for granted that in receiving cement it would be piled longside the mixer, so that not more than two men would be required to open bags and empty into mixer hopper,

Floor Finish

A part of the convention session, on "Field Problems," developed interesting material on floor finish.

After a careful study of the existing standards of the Institute floor finish Committee C—2, N. M. Loney, chairman, had only one recommendation to make—that special methods be allowed, but that no changes otherwise be made in the standard specifications.

A paper with a most practical flavor, from the viewpoint of a superintendent on the job, was presented by Joseph C. Grady, Boston, with a view to stimulating the effort to obtain the best cement finished floors possible for the varying uses to which they may be subjected, and at the same time give due consideration to the factors which must be studied and applied in each individual case. After considerable investigation and study of the question of finish for concrete floors, the writer of the paper concludes that finish placed some time after the structural slab will in general produce the most satisfactory final results.

Cement finished floors are divided into three distinct types, the descriptions of which are included in the following abstract:

Cement Finished Floors may be divided into three distinct types as follows:

A. Monolithic.
B. Finish placed later (on structural slab).
C. Finish and base placed later (on structural slab).

A.—Monolithc Finish

Where a building is carried up even in warm weather at a speed of six or eight days per story, the final results will be scratched and scarred floors that are very poor in appearance and will not stand up under heavy trucking. On the same operation, should the element of speed be disregarded to the extent of allowing each section of finish to be properly protected and workmen kept off it for three or four days, an excellent finish would be the result. This mode of procedure would rarely be possible, as the economy in design and material which belongs to this type of floor would be more than balanced by the interruption in the sequence of the various operations and the disrupting of the organization.

Important Details

1. Erect standard rain protection daily regardless of weather conditions.

2. Correctly proportion aggregates in rough concrete. An excessive amount of sand and cement will retard the water from draining off. Use only sufficient water to obtain a workable mix.

3. Rough Concrete should be carefully graded to allow for a uniform thickness of finish material—¾" is sufficient.

4. Rough Concrete of the proper consistency for reinforced work should be allowed to settle before screeds are set and before finish is spread. If this is not done and the finish is of proper consistency it will sink into the concrete and force the rough concrete to the surface. Pools of water on surface of rough concrete should be removed before finish is spread.

5. Run panels should be used to wheel finish over rough concrete. As each panel is removed, the smooth imprint left by the panel should be roughened and the displaced concrete brought to grade.

Monolithic Finish, Sprinkled Dry

This type of finish consists of "pulling up" the rough concrete by use of straight edge and short screeds clamped on column bars. When the water comes to the surface of the concrete, remove same by use of darby and straight edge. Sprinkle this surface twice with one to two dry sand and cement. The suggested placing of this dryer in two operations is due to the fact that the low spots which will require additional dryer are more easily detected after the first coat has been applied. The total of these dry applications should average about ¼" in thickness. When dry coats have become wet by absorption and surface will sustain knee boards, float and trowel in regular way.

This type of finish is recommended for floors which may be subjected to light wear or used for dead storage purposes.

B—Finish Placed Later

Except as noted under A, this type is recommended. The extra cost in design and materials is less than Winter Weather charges would be if the A type floors were laid during cold weather, and the final results are positive, while the A type results are uncertain.

Important Details

1. Great care should be taken in levelling and grading the rough concrete slab, allowing a uniform thickness of ⅞″ for finish to be placed later.

2. After rough concrete has been in place for several hours or has hardened sufficiently to sustain the weight of a man, use a steel wire push broom to sweep all fine material and laitance from the surface of the slab exposing the coarse aggregate. Do not use a rake.

3. Where floor finish is to be placed during cold weather, arrangements should be made to have the permanent heating system (if any) in operation before the floors are laid. Where salamanders must be used, sheet iron covers and flue pipes should be provided to carry coke gas out of building.

4. Prepare the rough slab to provide a bond for finish coat as follows: First. Remove all spots of mortar which have dripped from forms above, etc. Second. Thoroughly dry sweep well in advance of area to be finished. Third. In the afternoon of the day before finish is placed, thoroughly wash with clean water the area to be finished on the next day. Washing should be done with a hose with sufficient pressure to force out and carry away all sand and dirt or other foreign matter which may be lodged in pores or indentations of rough slab. The quantity of water necessary to properly wash the rough slab will often cause considerable trouble in the stories below where the washing is in progress.

Before finish is placed, sprinkle the rough slab with water, but do not create a surplus of water. Next apply a 1:1 cement grout and sweep thoroughly into the rough surface. Apply finish before this grout dries.

C—Finished Separate Slab

This type of finish generally consists of a 2″ base of cinder or stone concrete with a 1″ monolithic finish. This is the more expensive type of finish on account of the dead load, loss of story height, and extra materials, but has advantages where it is desired to bury small conduits, pipes, etc., between the rough slab and the finished slab. (Steam and hot water pipes excluded.) Joints should be cut as described later under "General" and finish mortar allowed to turn down full thickness of slab and about 2″ wide on all sides of each individual slab. This is to prevent curling. Screeds for this work should be set on dots the day before base concrete and finish are placed.

For best results, this floor should be laid in alternate sections, four slabs or sections to the ordinary bay.

General

Proportions for finishing coat:

1 part cement.
½ part sand.
1½ part grit or clean, hard rock (size ⅜″ down, with sand or dust removed).

In the finish or topping, use the minimum amount of water that will allow the finish to pull with a saw action on the straight edge without tearing apart, leaving a fairly smooth dense surface.

Finishing—Floor should be floated and troweled twice. The first operation should not take place until the finish has set enough to retain the knee boards on the surface. Floating and troweling of wet finish settles the coarse aggregate and brings fine material to the surface.

Floor Joints—Mason's jointer should not be used on any floor which may be subjected to trucking. The joint should consist of a knife cut only.

A-type floors should have knife cut joints at fill lines only.

B-type floors should have knife cut joints at fill lines and in finish directly over construction joints in slab.

C-type floor should have knife cut joints at fill lines, that is, at column centers and at center of bay in each direction.

After Protection—Cement finished floors should be kept saturated with water for two weeks after being laid. Water must not be applied until floor is hard enough to prevent blistering and peeling. This is wholly a matter of judgment and is dependent on atmospheric conditions.

A one inch layer of sawdust spread on the floor and kept thoroughly wet with water will assist in holding moisture, and properly protect and "cure" the floor.

A strip of burlap 3′ or 4′ wide laid at edge of preceding day's work and overlapping sawdust will help to prevent sawdust from being blown or dragged on to new work.

Hardness—Surface or after-applied hardeners will add somewhat to wear-resisting qualities of a floor which is subjected to grinding action from heavy trucking, that is, provided the floor contains the proper hard aggregate and is what might be called a good floor to start with.

Integral hardeners and accelerators are recommended for use in Type B and C finish, provided no mesh or reinforcement is to be placed in same. This type of hardener is also recommended for monolithic finish when used in connection with plain concrete, but should not be used in monolithic finish or reinforced concrete until more favorable information as to their action on metal is available.

Miscellaneous Items—Where artificial heat is used in connection with finish floor work, a temperature of about 60° should be maintained. Too much heat will cause floor to dust badly when dried out.

Placing of all floor finish should be arranged so that it will be unnecessary to wheel over newly laid work.

Test of Wear-Resisting Qualities

An extremely accelerated and concentrated test on a section of permanent floor finish by the Turner Construction Co. was described, together with the testing apparatus. The floor was of the B type and had been in place five and one-half months when tested.

The testing machine was so arranged that a total weight of 635 lbs. was concentrated on each of a pair of iron face wheels rotated on a 6 ft. 6 in. radius. A total travel equivalent to 269 miles, or 1,740 times per hour around the circle for 20 hours, caused a maximum wear of ⅛ in. and the floor was left practically uninjured.

The effect of such a test on a knife cut joint was determined by centering the testing machine on a knife-cut joint. The results were reported as very gratifying, no crumbling being evident on either side.

Kalman Cement Floor Finish

Cement floors installed by the Kalman Floor Co., using the basic principles covered by the Bruner patents, include the bonding of a finish coat several hours after the placing of the structural slab on the base, were presented in discussion. On the day before the finish is placed, the area to be covered is washed and the slab kept wet until the finish is applied. Dry cement is sprinkled on the wet surface and the resulting grout is swept into the pores in the rough slab immediately before the finish is placed.

Concrete consisting of 1 part cement, 1 sand and 1½ parts pea gravel or granite chips is rodded off after screeds have been set to established grade.

Following the rodding the surface is covered with loosely woven burlap strips, over which a dry mix of equal parts of cement and sand is spread. This layer, about 1 in. thick, acts as a blotter, absorbing the excess water.

About 20 minutes after the dryer is spread the burlap is removed and the moist material returned to the mixer for mixing with the proper amount of coarse aggregate for following batches.

An electrically driven impactor is used to bring sufficient moisture to the surface and troweling follows. The final troweling usually takes place within three hours. A layer of sawdust is used to keep the floor damp and a liquid floor hardener applied when the floor has dried out.

Metal Forms for Building Construction

The special committee on the application of metal forms to building construction, while not making definite recommendations, emphasized in its progress report the need for a careful study of conditions for each job before making a decision as to the kind of forms to be used. No sweeping generalizations are possible, the report stated, a factor of minor importance on one job may be of major importance on the next.

Some of the points to be considered by the contractor before committing himself to either wood or steel forms are given as follows:

I. *General—*

(a) Cost of materials; labor making, erecting and stripping form centering.

(b) Rental cost of metal form panels.

(c) Cost of erecting and stripping metal forms.

(d) Will the metal forms be delivered to the job in time to avoid delay to the construction work?

(e) Will the use of metal forms require employing a mechanical trade not otherwise needed on the building, and if so, will this possibly lead to labor complications?

(f) If metal forms are handled by sheet metal trade and carpenter labor is scarce, labor conditions may be improved by the use of metal forms.

(g) Will the use of metal forms necessitate purchasing lumber for various other purposes, such as bucks, grounds, bulkheads, etc., for which old form lumber is originally used?

(h) If metal floor forms are used, can they be utilized also for wall forms, saving the cost of wood, although the cost for labor on metal forms may be high?

(i) If wood forms are used for walls, will the excessive material cost overbalance possible economies otherwise offered by metal forms?

(j) Wlil the smooth surfaces resulting from the use of metal forms be desirable as giving a better appearance, reducing the cost of pointing or painting or other finishing, or as giving results in any way for which the owner would be required to spend additional money if wood forms were used?

(k) Will the smooth surfaces, or the possibility of their being oil-soaked, be detrimental and require the expenditure of money for special treatment preparatory to painting, plastering or otherwise finishing the surfaces?

(l) Winter weather construction. Metal forms to a slight extent lessen the fire hazard where salamanders are in use, and because of the heat-conducting qualities of the metal make it easier to keep the poured concrete above 70° while setting.

II. *Rental Basis—*

If the general contractor rents the metal form panels and erects with his own labor, the following points should also be considered.

(a) Will the use of metal forms cause labor difficulties due to jurisdictional disputes as to which trade should handle them?

(b) If metal forms cannot be handled by carpenters, will this disorganize the labor forces by necessitating intermittent hiring and discharging the different trades, or can the job be organized to give continuous employment to all trades, thus making employment attractive to the best workmen?

III. *Sub-Contract Basis—*

If the erection and handling of metal forms is let on a sub-contract either to the form manufacturer or to an outside erector, the following points should be considered:

(a) Will the introduction of another sub-contractor tend to slow up the progress of the job and thereby result in an increased cost of any part of the work? On rush jobs this question of the general contractor losing the absolute control over the speed of the work that he has when all the form-work is done by his own organization, may be of extreme importance.

(b) Will the introduction of another sub-contractor tend to simplify or complicate the labor situation? If local labor is scarce, bringing in an outside organization may relieve the situation somewhat.

(c) Can the sub-contractor be depended upon to co-operate with the others to the best advantage of the job as a whole; or will his presence (since he will be primarily interested in the cost of his own work, regardless of others), tend to increase the cost of other work?

The committee reported that the opinion among contractors seems to be unsettled on the question of superiority of ceiling finish obtained by the use of metal forms. The joints are less in number, and some feel, therefore, are more conspicuous. There are no costs available to show whether there is any saving in pointing charges on the ceilings.

Discussion of the report brought out the apparent opinion among contractors that while the use of steel forms has become accepted practice for certain types of construction, systems for use in building construction have not been fully developed to an economical basis. Methods for holding the reinforcing steel in place in the steel forms and for placing inserts are points believed to require further development.

The use of expanded metal as forms for concrete was suggested and several instances cited where this metal fabric proved successful, it having the tendency to regulate automatically the water content by allowing the excess water to drain through the mesh. This use is not new, as several systems of house construction use metal lath forms, and such forms have been used on a good deal of circular work.

Mechanical Solution of Statically Indeterminate Structures

A method for accurately determining stresses in members of statically indeterminate structures by the use of paper or celluloid models was described in a clear and concise abstract of his paper, entitled "An Accurate Mechanical Solution of Statically Indeterminate Structures by Use of Paper Models and Special Gauges," by Prof. George E. Beggs, of Princeton University. With the aid of the models, Prof. Beggs demonstrated the method he has developed for determining stresses in members of indeterminate frames by measuring deflections of the members of the models at critical points. Deflections are measured by micrometer microscopes and the stresses computed by aid of the ratio of the deflections under a known applied load.

Results obtained by the mechanical solution check very closely the results obtained by exact theory by the slope-deflection method which involves the solution of a number of equations. An independent check on the results obtained by the mechanical solution can be made by applying the results in the three equations of equilibrium. The agreement of values between the values obtained by the mechanical determination and by exact theory is remarkably good.

Corrosion of Steel Reinforcing

In a paper on the corrosion of steel reinforcing in concrete buildings by Manton E. Hibbs, Structural Engineer, Bureau of Building Inspection, Philadelphia, among the buildings referred to where corrosion of the reinforcing appeared of a serious nature, was the Baldwin Locomotive Works, where some of the reinforcing steel on the outer members was exposed by the spalling of the covering of concrete, showing the exposed steel to be effected by the gases and moisture in the atmosphere. It was pointed out that the number of instances where such effects have been noted is very small, considering the large number of concrete structures that have been inspected.

Discussion of the Joint Committee Report

In the discussion of the progress report of the Joint Committee on Concrete and Reinforced Concrete, the main criticism was centered on section 28 of the tentative specifications, which provides methods for determining the proportions in which the cement and aggregates shall be mixed. The main opposition expressed was to the method of specifying concrete by strength.

D. H. Dixon, of the Turner Construction Co., representing the New York Contractors' Committee, in contending that it would be illogical to establish the tests of cylinders at 28 days as a criterion of the strength of concrete in buildings, referred to tests made on eight different brands of cement purchased on the New York market. Four brands were expected to test low and four high at 28 days. The results of the tests confirmed the expectations, there being a range of 100% in the strength of the brands tested. It was further stated, however, that cements which tested low at 28 days gained strength so as to give a satisfactory test at the end of a longer priod. One of the results mentioned as a possible outcome of specifying concrete by strength was the selection only of cements that show a high test at 28 days.

The present wide variations shown in the strength of test specimens taken from apparently identical mixtures of concrete, according to F. V. Warren, representing the Philadelphia Contractors' Committee, is mainly due to the varying properties of the fine and coarse aggregates and to the water ratio. When the grading is determined and the consistency controlled, uniformity is obtained. The Philadelphia committee recommended the installation and use of the proper water measuring devices, and the frequent and regular use of the slump test or any other workable method of controlling the water ratio. It was contended that the results sought by Section 28 can best be obtained by more detailed and rigid requirements of field operation.

The Philadelphia committee's objection to judging of concrete entirely on the compressive strength of test cylinders at 28 days was also based upon the possibility of variations in conditions under which tests may be made and the fact that many cements do not give high compressive tests at that period but do over a longer time.

In general discussion, other questions that arose were relative to the time of mixing, the possibility of a personal equation entering the strength tests, the dependability of one or a small number of tests and the possibility of a wide range of results from tests using different brands of cements under identical conditions.

In discussing the time of mixing, ½ to ¾ minutes after the material has been placed in the mixer was recommended.

In answering the discussion as to the variation in strength developed by different brands of cement, the question was asked as to whether the same concern was felt in regard to existing concrete structures which were built under former methods of proportioning, and if these structures are viewed with the same apprehension and alarm as the variations existing in concrete test specimens.

General discussion of details of construction brought out the opinion in favor of increasing distance between construction joints in buildings where possible, 200 ft. being considered a short length between joints. Joints perpendicular to the line of forces were recommended, in place of joints built on an angle of 45°, as some have been constructed.

Discussion of waterproofing in concrete structures favored specifications calling for results to be obtained, rather than giving details of operation, since the latter would tend to destroy initiative.

Comparative Costs of Buildings

A. R. Lord, chairman of the Committee on Reinforced Concrete Building Design and Specifications, and member of the Joint Committee, presented a report of the work of the Institute Committee, which included the three principal items:

(a) A study of the problem of specifying concrete by strength and related matters, including factor of safety.

(b) Discussion of the technical provisions of the 1921 report of the Joint Committee.

(c) Investigation of the cost of structural members under the 1921 Joint Committee report as compared with the present cost under city building codes, excluding the matter of cost of producing concrete of any given strength.

The committee reported that the matter of specifying concrete by strength had been approached as a possible development of the future toward which active steps should be taken to investigate its practicability and desirability and to develop whatever data need be secured if it is to be equitably and safely applied.

An analysis was presented, showing the cost of concrete buildings designed according to the Joint Committee and American Concrete Institute standards, as compared with those designed under the building codes of various cities.

The analysis was based on information received on sheets sent to well known engineers. Each sheet included the design and quantities for the following members:

1. One one-way solid slab 12 ft. clear span, 300 lbs. live load.
2. Nine beams, loads 1,000 to 2,000 lbs. per ft., spans 16 ft. to 24 ft.

Six girders, 20,000 to 40,000 loads at third points, internal and end spans.

3. Nine flat slabs, load 100 to 300 lbs. per sq. ft., spans 16 ft. to 24 ft.
4. Six footings, load 200,000 lbs. to 1,000,000 lbs. soil at 4,000 and 6,000 lbs.
5. Five spiral columns, loads 200,000 to 1,000,000 lbs., 12-ft. story.
6. Four tied columns, loads 50,000 to 200,000 lbs., 12-ft. story.

(a) The cost of forms is not included.

(b) Costs are given for members and not for complete structures.

(c) Differences in the cost of excavation are not considered.

(d) The strength of the concrete has been assumed as 2,000 lbs. per sq. in., and the cost of 2,000 lbs. of concrete assumed to be that of 1:2:4 concrete.

(e) Bond provisions have been disregarded in a large measure.

The average cost of concrete and steel based upon the values used by the engineers in the comparison are as follows:

2,000 lbs. concrete in place in forms	$ 9.50 per cu. yd.
2,500 lbs. concrete in place in forms	11.00 per cu. yd.
2,900 lbs. concrete in place in forms	12.50 per cu. yd.
3,000 lbs. concrete in place in forms	12.80 per cu. yd.
Reinforming steel bent and placed	62.00 per ton
Column vertical bars, in place	60.00 per ton
Column spiral, in place	78.00 per ton

These figures are intended to cover contractor's profit and all job expense commonly charged against the concrete work.

Tables 1 (*a*) and 1 (*b*), incorporated in the committee report, are cited as conclusive as to the needs of uniformity of building codes.

The design and costs of individual members as given thus far is essential to the critical comparison of the specifications, but a better general view may be obtained by preparing figures for a complete building and showing the cost comparison on this basis. To this end we have taken the following distribution of cost from figures prepared by the New York Contractors' Committee, for a building 80 x 300, six stories, and averaging live loads usually employed. Each percentage represents the proportionate part of the total cost attributable to each type of structural member.

	Flat Slab Building	Beam and Girder Building
Floors and roof	65%	68%
Tied columns	8%	9%
Spiral columns	12%	11%
Footings	13%	10%
Walls, etc. (of concrete)	2%	2%
Total	100%	100%

Table 2 has been prepared from Table 1 and these percentages represent the ratio of cost under Joint Committee provisions to the cost on the basis outlined in preceding paragraphs for the various cities and the American Concrete Institute specification of 1920. This table may be summed up as given below. It should be remembered that these figures are but rough approximations for any given city, but the average is probably quite indicative of the nation-wide situation. They should be studied rather than memorized.

Table 2—Ratio of Joint Committee to Other Specifications

Code or Specification	Flat Slab Building	Beam and Girder Building
Amer. Concrete Institute, 1920	1.09	0.90
Chicago	1.03	0.87
Philadelphia	1.02	0.74
Cleveland	0.98	0.68
New York	1.11	1.00
Detroit	1.13	0.98
Cincinnati	1.24	1.10
San Francisco	1.02	0.91
Average of eight	1.08	0.90

These figures are for the cost of the steel and concrete only. To get at building costs, the approximately constant costs of excavation, brickwork, mill work, plumbing, electrical work, heating, roofing, formwork, etc., must be added. The costs covered in the above figure may be taken to represent roughly 20% of the cost of the completed buildings, and if so taken the average figures are reduced to:

1.02 for flat slab building
0.98 for beam and girder building

Even if the cost of the concrete and steel were considered as great as 30% of the entire cost of the building, these figures would be:

1.02 for flat slab building
0.97 for beam and girder building

Table 1 (*a*)

Kind of Member	No. of Values	Material	Unit Cost	Joint Committee Specification —1921—		Amer. Concrete Inst. Spec. —1920—		—Chicago—		—Phil'd'lphia—	
				Amt.	Cost	Amt.	Cost	Amt.	Cost	Amt.	Cost
One-way solid slab	1	2,000 lbs. Conc.	$9.50	70.5	$24.80	78	$27.50	81	$28.50	92	$34.20
		Reinf. Bars	62.00	345	10.70	386	12.00	344	10.70	382	11.90
Total cost					35.50		39.50		39.20		46.10
Tee Beams and Girders	15	2,000 lbs. Conc.	$9.50	33	10.60	43	15.10	42.5	15.00	46	16.20
		Reinf. Bars	62.00	290	9.00	336	10.40	276	8.60	382	11.90
Total cost					19.60		25.50		23.60		28.10
Flat slabs	9	2,000 lbs. Conc.	$9.50	326	115.00	324	114.20	322	113.40	294	103.50
		Reinf. Bars	62.00	1440	45.60	1146	35.50	1140	35.30	1220	37.80
Total cost					160.60		149.70		148.70		141.30
Footings	6	2,000 lbs. Conc.	$9.50	235	82.80	225	79.20	343	120.80	480	169.00
		Reinf. Bars	62.00	921	28.50	1150	35.60	577	17.90	934	29.00
Total cost					111.30		114.80		138.70		198.00
Spiral Columns	5	2,000 lbs. Conc.	$9.50			6	2.10			16.5	5.80
		2,500 lbs. Conc.	11.00			7.5	3.10			46	18.80
		2,900 lbs. Conc.	12.50	38	17.60	33.5	15.90	63.5	29.40		
		3,000 lbs. Conc.	12.80								
		Vertical Bars	60.00	830	24.90	421	12.60	306	9.20	564	16.90
		Spiral Steel	78.00	166	6.50	283	11.00	236	9.20	268	11.40
Total cost					49.00		44.70		47.80		52.90
Tied columns	4	2,000 lbs. Conc.	$9.50	5.5	1.90	3	1.10	5.5	1.90	28	9.90
		2,500 lbs. Conc.	11.00	6.5	2.70	4	1.60	6.5	2.70		
		2,900 lbs. Conc.	12.50	18.5	8.60	12	5.70	18.5	8.60		
		3,000 lbs. Conc.	12.80								
		Reinf. Steel	62.00	76	2.40	66	2.10	78	2.40	190	5.90
Total cost					15.60		10.50		15.60		15.80

Table 1 (*b*)

Kind of Member	No. of Values	Material	Unit Cost	—Cleveland—		—Detroit—		—Cincinnati—		San Francisco	
				Amt.	Cost	Amt.	Cost	Amt.	Cost	Amt.	Cost
One-way solid slab	1	2,000 lbs. Conc.	$9.50	75.5	$26.60	81.5	$28.70	89.5	$31.50	70	$24.60
		Reinf. Bars	62.00	380	11.80	325	10.10	262	8.10	30	9.30
Total cost					38.40		38.80		39.60		33.90
Tee Beams and Girders	15	2,000 lbs. Conc.	$9.50	52.5	18.50	38	13.40	34	12.00	38.5	13.60
		Reinf. Bars	62.00	488	15.10	256	7.90	220	6.80	282	8.80
Total cost					33.60		21.30		18.80		22.40
Flat slabs	9	2,000 lbs. Conc.	$9.50	306	107.80	308	108.60	287	101.10	316	111.30
		Reinf. Bars	62.00	1460	45.20	965	29.90	870	27.00	1316	40.80
Total cost					153.00		138.50		128.10		152.10
Footings	6	2,000 lbs. Conc.	$9.50	423	149.00	394	138.80	209	73.60	434	152.80
		Reinf. Bars	62.00	758	23.40	671	20.80	629	19.50	660	20.50
Total cost					172.40		159.60		93.10		173.30
Spiral Columns	5	2,000 lbs. Conc.	$9.50	47.5	16.70						
		2,500 lbs. Conc.	11.00					65.5	26.70		
		2,900 lbs. Conc.	12.50								
		3,000 lbs. Conc.	12.80			56	26.60			55	26.10
		Vertical Bars	60.00	913	27.40	166	5.00	325	9.80	254	7.60
		Spiral Steel	78.00	200	7.80	284	11.10	240	9.40	194	7.60
Total cost					51.90		42.70		45.90		41.30
Tied columns	4	2,000 lbs. Conc.	$9.50	19	6.70	3	1.10	7	2.50	29	10.20
		2,500 lbs. Conc.	11.00					12	4.90		
		2,900 lbs. Conc.	12.50								
		3,000 lbs. Conc.	12.80			14.5	6.90				
		Reinf. Steel	62.00	306	9.50	62	1.90	104	3.20	135	4.20
Total cost					16.20		9.90		10.60		14.40

Fireproofing

The Committee on Fire-Resistant Qualities of Pebble Aggregates presented a progress report recommending further consideration of the provisions of the Joint Committee's progress report relative to the expansion of aggregates. A narrow interpretation of the provisions, it is pointed out, would seem to make it necessary to discard all gravels containing an appreciable amount of silicious material. Some practical means of indicating what shall be considered a satisfactory or unsatisfactory silicious gravel, either by chemical test or by physical measurement, is recommended.

Tests were cited in which silicious materials were less effective than other forms of aggregate against fire, and the conclusion drawn that concrete containing silica pebbles in the aggregate will undoubtedly prove satisfactory as a fire-resistant up to a certain temperature. The committee suggests that the fitness of an aggregate for use in fire resisting concrete may be determined by a test similar to the so-called "spalling" test used for refractory bricks, and that the material be deemed unsatisfactory for service as an aggregate of fire-resisting concrete, when it failed to pass some such simple test.

Proposed Chimney Standards

Proposed standard specifications for the design and construction of tapering reinforced concrete chimneys were presented by Eric Plagwit, chairman, Committee S—1, Reinforced Concrete Chimneys. Exception was taken to some features of the proposed standards in written discussions presented by Edward Godfrey and John W. Lowell.

A Highway Inspector Course Inaugurated by Wisconsin

A new course for highway inspectors has just been started for the first time in Milwaukee by the University of Wisconsin Extension Division. About 20 men will enroll in the first term. The course will consist of two terms, and a summer course may possibly be given. The two-term course is planned to give prospective inspectors on highways practical education in a minimum of time. It is conducted as a regular day school, and the students will attend classes for a certain number of hours each day. In order to enter the course, the student must have the equivalent of a common school education. After the student has satisfactorily completed all of the required work, a certificate will be issued by the University Extension Division. Then he will be eligible to enter the course for highway engineers in the fall of 1922, and which continues for four terms of nine weeks each.

Highway engineering, drawing, surveying, highway grades, drainage, roads, pavements, material specifications, highway office practice, highway cost data and estimates, minor highway structures, and Wisconsin highway standards, are among the subjects to be treated.

The Proceedings of the American Concrete Institute are free to members. Address American Concrete Institute, 1807 East Grand Blvd., Detroit, Mich.

How's Business?

As business gets into step for 1922, it becomes increasingly evident that the recovery of industry in general is well under way and that the construction field, whose recovery has for the past few months recorded a speed greater than that of the average industry, is actually leading business back to normal.

That this isn't mere theory is shown by F. W. Dodge reports of building permits issued in 20 principal cities in January, totalling in valuation over a hundred million dollars, more than twice the value of permits issued in any previous January. Taking a wider territory, figures on 194 cities show permits issued in January 125% greater in value than those in January last year.

Greater labor efficiency and a considerable deflation of material prices are the two factors that have brought building cost down nearer reason, and continued improvement of these two factors will undoubtedly add speed not only to the return of good business in the construction field, but of general prosperity as well.

The highway improvement program is bound to be a powerful factor in employing construction labor, and in the consumption of construction supplies.

General business factors may be summed up as follows:

World Conditions—Foreign exchange, particularly British, has improved steadily. The prospect of a World Economic Conference is taken by Big Business to promise an ultimate cure for world-wide business depression.

Iron and Steel—Steel mills are increasing output, orders are multiplying and prices stiffening. Outlook excellent, compared to last six months.

Textiles—Woolen lines most prosperous. Cotton unsettled. Labor troubles in cotton mill holding up the parade.

Silk—Market unsettled. Prices declined sharply and demand is spotty.

Automobiles—Export demand increasing. Production being speeded up. Deflation accomplished. Domestic trade improving.

Transportation—Railroads doing better. No horizontal reduction in freight rates expected, but reduction in rates on some commodities seems certain, namely, on coal, metals, wood and agricultural products.

Cost of Living—Coming down. Following table shows the per cent of *increase* of cost of living from the 1913 average.

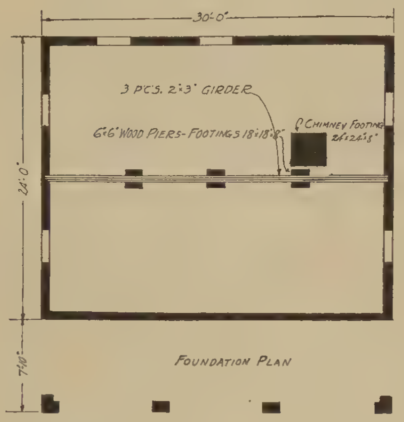
PER CENT OF INCREASE FROM 1913 (AVERAGE) TO:

Item of Expenditure	December 1915	December 1920	December 1921
Food	5.0	78.0	50.0
Clothing	4.7	158.5	84.4
Housing	1.5	51.1	61.0
Fuel and light	1.0	94.9	81.1
Furniture and furnishings	10.6	185.4	118.6
Miscellaneous	7.4	108.2	106.8
	5.1	100.4	74.3

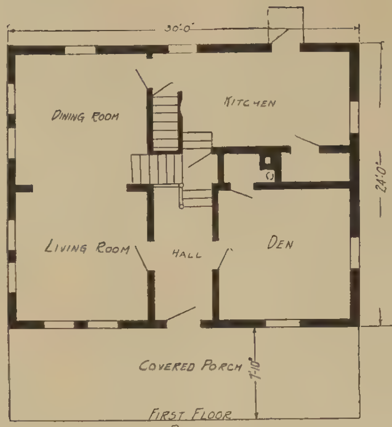
Failures—January failures, as expected, were large—the largest ever recorded for one month. On the other hand, business enterprise is taking heart, January recording a big increase in the number and size of new companies incorporating for business.

Stock Market—The prices of stock in various industrial enterprises are consistently advancing. Business men know that the stock market by its action discounts general industrial activity six months ahead.

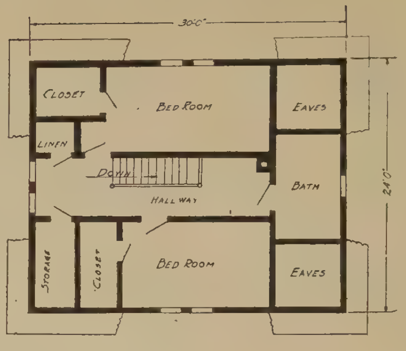
Bond Market—Sales expand and prices improve. Dow-Jones bond index for January showed average prices $70.22, compared to $64.10 in December.


30'-0"
3 PCS. 2"×3" GIRDER
6"×6" WOOD PIERS-FOOTINGS 18"×18"×8"
CHIMNEY FOOTING 26"×26"×8"
24'-0"
7'-10"

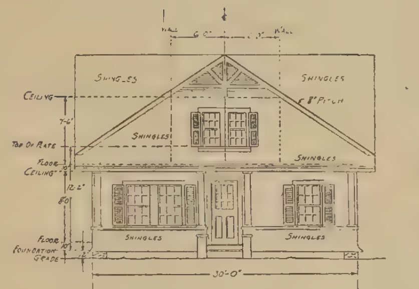
FOUNDATION PLAN



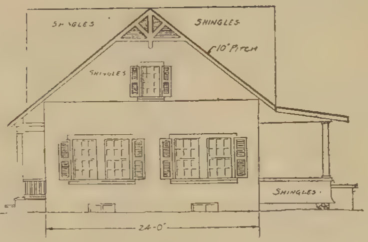
FIRST FLOOR PLAN



SECOND FLOOR PLAN

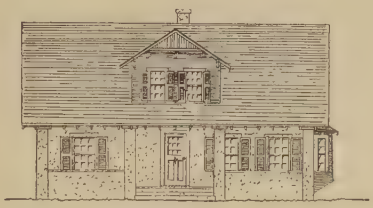


FRONT ELEVATION

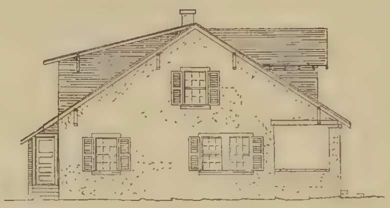


SIDE ELEVATION

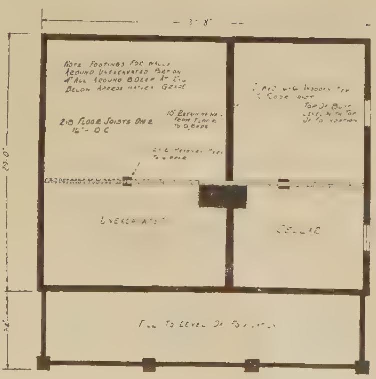
Plans and elevations of Concrete Houses built by L. C. Thompson, near New Haven, Conn., by methods described in CONCRETE for January, 1922.



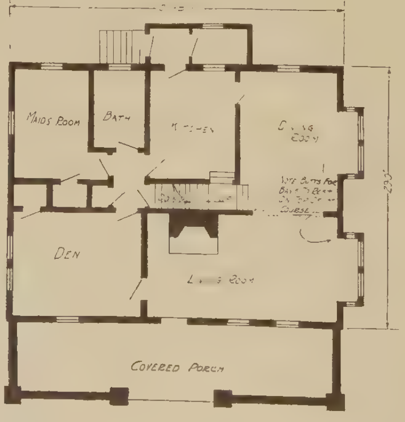
FRONT ELEVATION



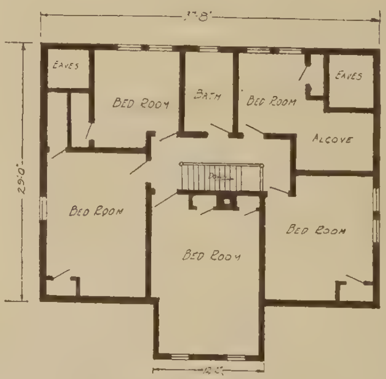
SIDE ELEVATION


37'-8"
NOTE FOOTINGS FOR WALLS AROUND UNEXCAVATED PORTION 4" ALL AROUND 8" DEEP AT 2'-0" BELOW APPROXIMATE GRADE
2×8 FLOOR JOISTS ONE 16" O.C.
10" BEAM FROM FLOOR TO GRADE
UNEXCAVATED
CELLAR
TOP OF BUTT LEVEL WITH TOP OF FOUNDATION
29'-0"
FILL TO LEVEL OF FOUNDATION

FOUNDATION PLAN

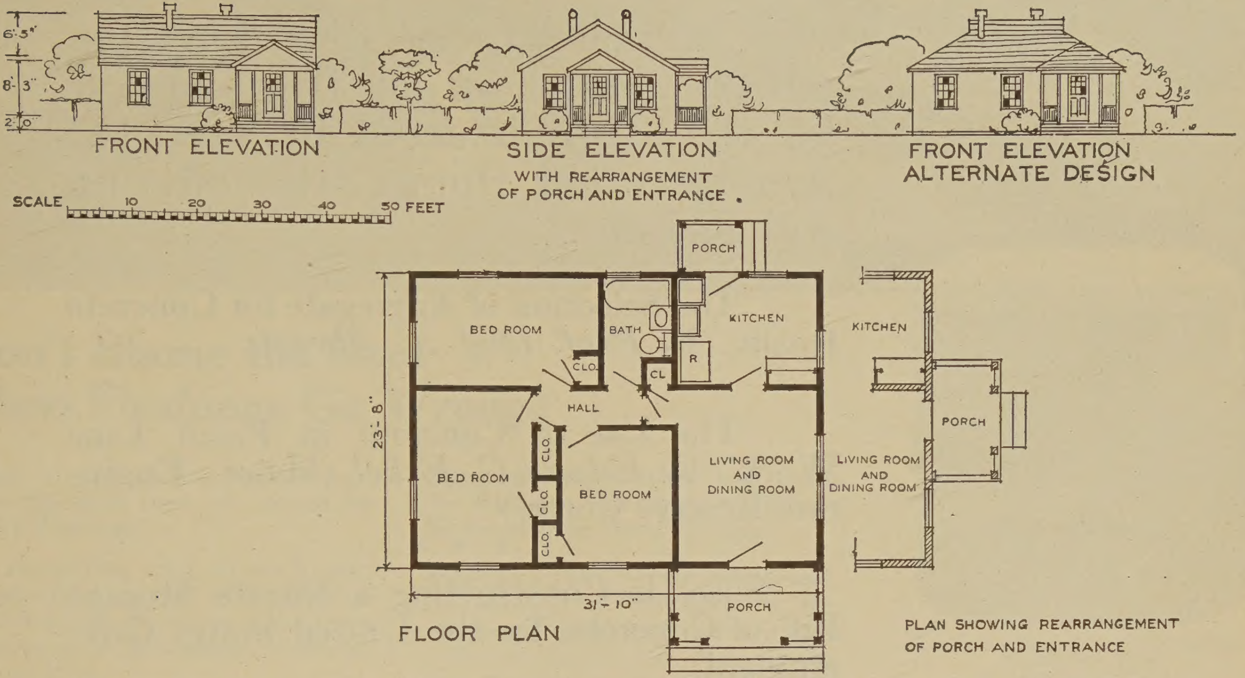


FIRST FLOOR PLAN



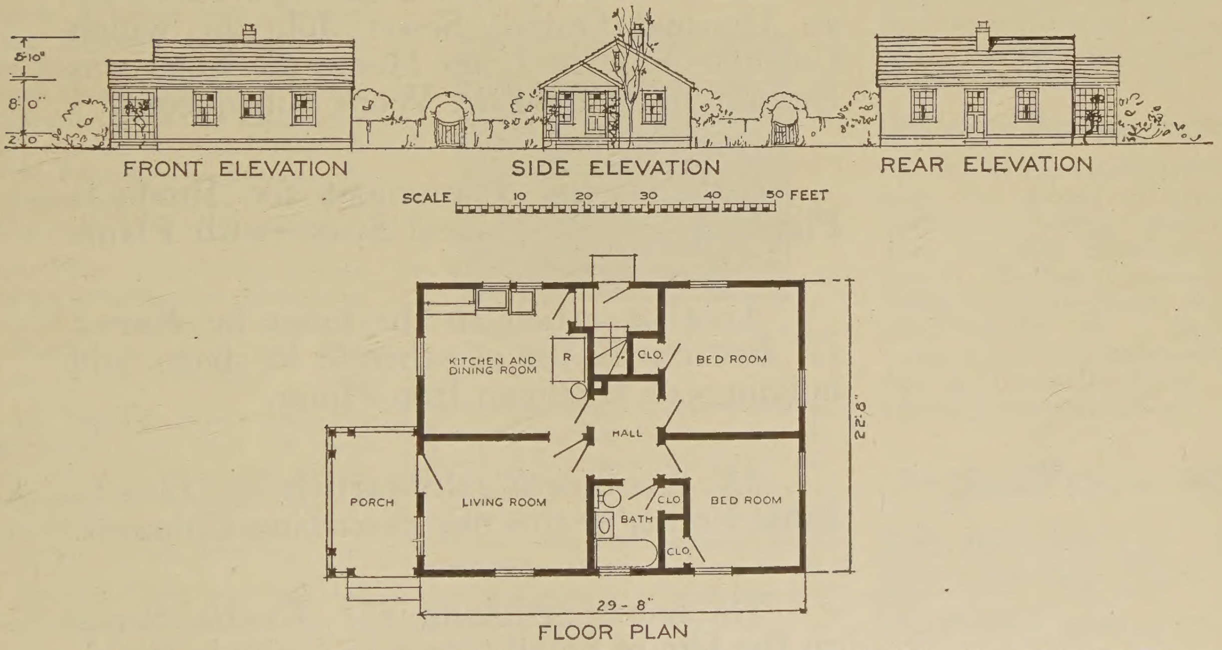
SECOND FLOOR PLAN

United States Government Bungalow Plans


6'-5"
8'-3"
2'-0"
FRONT ELEVATION
SIDE ELEVATION
WITH REARRANGEMENT OF PORCH AND ENTRANCE
FRONT ELEVATION ALTERNATE DESIGN
SCALE 10 20 30 40 50 FEET
PORCH
BED ROOM
BATH
KITCHEN
CLO.
CL
R
HALL
23'-8"
CLO.
CLO.
CLO.
BED ROOM
BED ROOM
LIVING ROOM AND DINING ROOM
31'-10"
PORCH
FLOOR PLAN
KITCHEN
PORCH
LIVING ROOM AND DINING ROOM
PLAN SHOWING REARRANGEMENT OF PORCH AND ENTRANCE

FIVE ROOM BUNGALOW USHC STANDARD TYPE D

SCALE 5 10 15 20 25 FEET



FOUR ROOM BUNGALOW USHC STANDARD TYPE C

SCALE 5 10 15 20 25 FEET

UNITED STATES HOUSING CORPORATION

In April—

Unusual variety of interesting articles shows up in the schedule for the April issue of CONCRETE. Among other things, the offering will include:

"The Selection of Aggregate for Concrete Roads" by *Prof. Duff A. Abrams.*

* * *

"The Use of Concrete in Front Line Work" by *Edwin C. Eckel* (Major, Engineers Reserve Corps.)

* * *

Speed in Constructing a Nitrate Storage Pit, of Concrete, for the United States Government.

* * *

Manufacturing and Field Operations on an Unusual Outfall Sewer Job on which Concrete Pipe in Long Heavy Sections was Employed—Part of the Work Subaqueous.

* * *

Layouts and Equipment for Products Plants of Several Typical Sizes—with Plans.

* * *

Another article in the series by *Byron G. Best* on the use of concrete in shafts and buildings of Michigan Iron Mines.

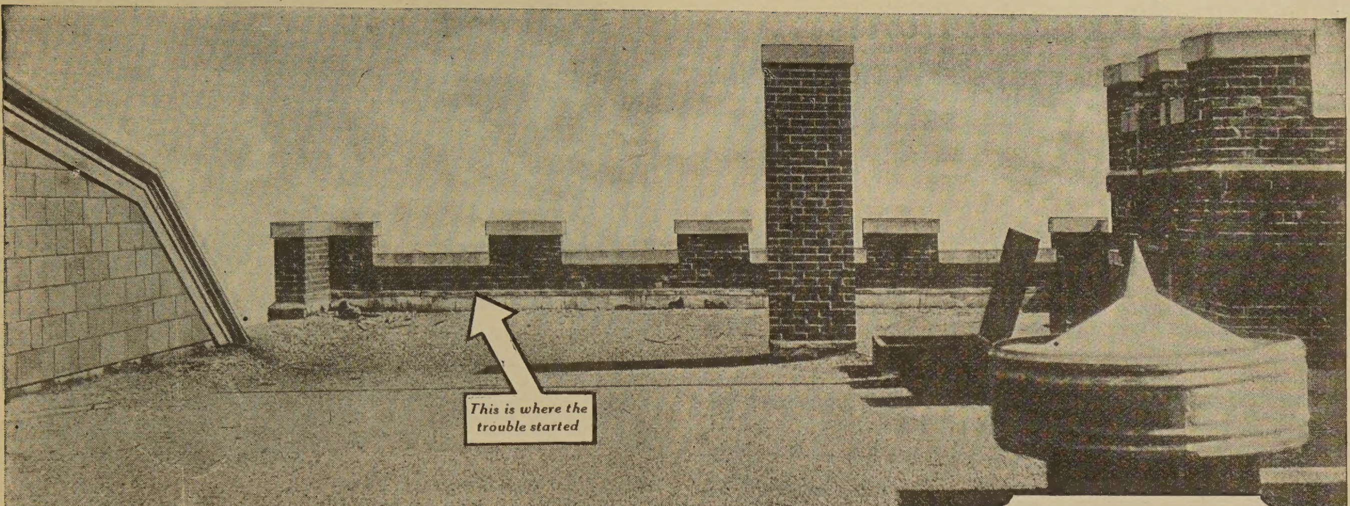
* * *

Mr. Lockhardt's third article on "*How* to Build Forms"—this one describing Columns.

* * *

The fourth article in *Mr. Curtis'* Series on the Use of Small Concrete Units in Building Houses.

These things account for only about half of the *April Issue.*



Don't Blame the Roof when Flashings Go Wrong!

Many a good roof is held responsible for leaks that are caused by faulty flashings.

An interesting case of such misplaced blame is that of the Barrett Specification Roof on the State Armory at St. Johnsbury, Vermont, laid in 1916.

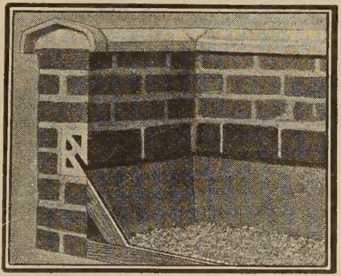
Some months ago, when the architect's plans for a new armory at Newport, Vermont, were submitted to the Adjutant General of the State, he refused to approve them because they called for a Barrett Specification Roof. In explanation of his refusal, he stated that the Barrett Specification Roof on the St. Johnsbury Armory had been leaking badly for several months.

The architect immediately investigated the trouble at St. Johnsbury. What he found there is shown by the illustrations. The roof itself was in perfect condition.

But the flashings, which were the usual metal type, were in sorry shape. All but two joints of the base-flashings had pulled apart and the counter-flashings in many places had broken away from the wall.

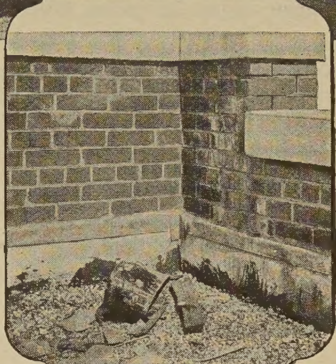
The settling of the building, and contraction and expansion due to changing temperatures, had made the flashings absolutely worthless. No wonder the "roof" leaked!

When these facts and the photographs were brought to his attention, the Adjutant General promptly approved a Barrett Specification Roof for the new Armory at Newport, Vt., but insisted that Barrett Flashings be used instead of metal.



The new Barrett Flashings. Note how slot in flashing-block takes care of expansion and contraction.

For permanent flat-roof buildings Barrett Specification Roofs are the choice of leading architects and engineers. This popularity is due to an enviable record for durability and economy. There are many roofs of this type that have been in service forty years or more and are still in good condition.



Close-up showing condition of metal flashings on St. Johnsbury Armory. No wonder the "roof" leaked!

Barrett Specification Roofs are moderate in first cost and are guaranteed *by a Surety Company Bond,* against all roof repair expense,—Type "AA" for 20 years; Type "A" for 10 years.

No more flashing troubles!

The new Barrett Flashings definitely solve the problem of permanent waterproof flashing construction. They are fully described in the Barrett Flashing Handbook and Flashing Service Sheets, copies of which will be sent to architects, engineers and contractors requesting same on business letterhead. Please address our nearest office.

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Barrett Specification Roofs Bonded for 20 and 10 Years

Organizations

American Concrete Institute; Secretary, Harvey Whipple, 1807 East Grand Boulevard, Detroit.

American Concrete Pipe Association, M. W. Loving, Secretary, 111 West Washington St., Chicago.

Associated Metal Lath Manufacturers, Edison Bldg., Chicago; Wharton Clay, Commissioner.

Iowa Cement Stave Silo Association; H. E. Kilmer, Secretary, Oskaloosa, Ia.

Mid-West Concrete Products Assn., Frank Whipperman, Secretary-Treasurer, 3045 Fowler Bldg., Omaha, Neb.

National Crushed Stone Assn.; A. P. Sandles, Secretary, 405 Hartman Bldg., Columbus, Ohio.

National Housing Assn.; Lawrence Veiller, Secretary and Director, 105 East 22nd St., N. Y. C.

The National Lime Association; Mather Bldg., Washington, D. C.

National Sand and Gravel Producers' Association; E. Guy Sutton, Secretary, Williamsport, Ind.

The National Concrete Stave Silo Asociation; W. G. Kaiser, Secretary, 111 West Washington St., Chicago.

At the annual meeting of the Directors of the National Slag Association, held January 28th, at the offices of that organization at 933 Leader-News building, Cleveland, Ohio, the following officers were elected for the coming year: President, L. A. Beeghly, Standard Slag Co., Youngstown, O.; vice-President, C. E. Ireland, Birmingham Slag Co., Birmingham, Ala.; secretary-treasurer, H. J. Love, Cleveland, O. The members of the Executive Committee for 1922 will be: L. A. Beeghly, Standard Slag Co., Youngstown, O.; E. H. Kuttner, Illinois Improvement & Constr. Co., Chicago; C. L. McKenzie, Duquesne Slag Products Co., Pittsburgh, Pa.; L. H. Hawblitz, France Slag Co., Toledo, Ohio; H. N. Snyder, Buffalo Slag Co., Buffalo, N. Y., and J. M. Truby, Cleveland Builders Supply & Brick Co., Cleveland, O.

Electric Drill and Grinder

There is a new portable electric combination tool,[1] which may be used either as a drill or a grinder. By the use of one motor it has the proper speed both for drilling and grinding. It can be used for drilling holes in metal and wood, and when used with grinding wheel attachment will cover the average requirements for grinding. It has a drilling capacity of 1/8 in. to 5/8 in. in steel, and carries a 6 in. by 3/4 in. grinding wheel. Both a slow speed and high speed are provided. The weight of the tool is only 18 lbs., while the motor develops 1/2 h. p. under load. The motor is of the universal type, and can be operated on both direct and alternating current of the same voltage.

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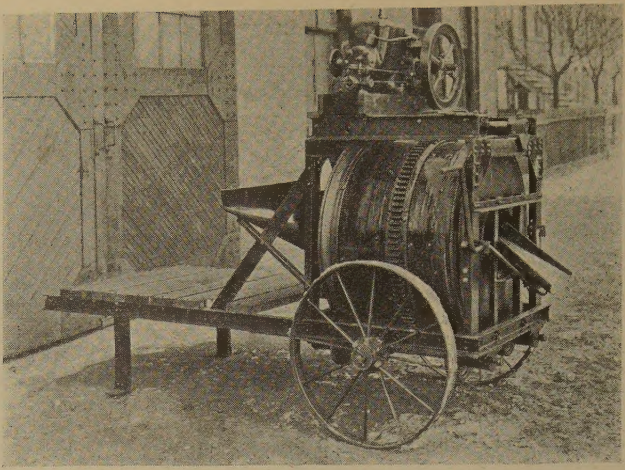
[1] Wodack Electric Tool Corp., Chicago.



ARCHER JUNIOR CONCRETE MIXER

Archer Mixer

The illustration shows the new Archer Junior concrete mixer of 3 cu. ft. capacity per batch. This mixer is built along the same lines as the rest of the Archer line, is quick loading, portable, and end-discharging. It can be handled with a small crew. The manufacturers say it will handle a half-bag mix on almost any proportion of materials.

It is equipped with a 1½-horse power Fairbanks-Morse engine, with Bosch magneto, and is also fitted with clutch and chilled drum rollers.

The PEERLESS
Cement Brick Machine

ONE MAN OPERATES IT

All brick made face down and delivered face up.

High class faced brick made almost as rapidly and as cheaply as common brick.

The present price of brick is very high and they will be scarce at any price.

Make cement brick and make money. There is a large profit to be made. We start you right.

We positively guarantee more perfect brick can be made in a day on the Peerless Machine than on any other machine on the market. Your money cheerfully refunded if not satisfied.

Our PEERLESS POWER MACHINE beats them all. Tamps ten brick perfectly in four seconds.

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